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DETERMINING DURATIONS FOR RIGHT-OF-WAY ACQUISITION AND UTILITY ADJUSTMENT ON HIGHWAY PROJECTS

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DETERMINING DURATIONS FOR RIGHT-OF-WAY ACQUISITION AND UTILITY ADJUSTMENT ON HIGHWAY PROJECTS

by

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Dedication

To my Lord and

my lovely family

with love and appreciation

.

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DETERMINING DURATIONS FOR RIGHT-OF-WAY ACQUISITION AND UTILITY ADJUSTMENT ON HIGHWAY PROJECTS

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For the Texas Department of Transportation (TxDOT), accurately predicting durations for right-of-way (R/W) acquisition and utility adjustment on highway projects has been deemed as one of the most important capabilities that regional districts should possess. Because this need is so pressing, TxDOT has sought to establish an effective methodology for predicting the durations of these two pre-construction processes. The "Right-of-Way Acquisition and Utility Adjustment Process Duration Information (RUDI) tool" was developed, which is an Excel-based tool that takes into consideration user inputs regarding project circumstances such as schedule urgency and levels of uncertainty.

In this study, the accuracy of RUDI and the key drivers that affect the durations of R/W acquisition and utility adjustment have been examined in order to assess RUDI's effectiveness in implementation on projects, to identify critical needs for enhancing

RUDI, and to understand how practitioners can better predict durations needed for R/W acquisition and utility adjustment.

RUDI proved useful in predicting durations with better accuracy in spite of limited data availability. Specifically, RUDI provided practitioners with reasonable duration ranges that can be used in better forecasting the durations of utility adjustment. Moreover, the study revealed that practitioners with more than 13 years of experience and R/W acquisition specialization showed better performance in estimating durations for R/W acquisition. Accurately estimated durations for utility adjustment were mostly provided by practitioners working at districts located in urban or metropolitan areas in Texas.

The drivers identified significantly influential in predicting durations for R/W acquisition by the practitioners include "TxDOT Project Type," "District R/W Annual Budget," "Dedication of Funds to the Project," "Funding Limitations for the Project," "Level of Political Pressure," "Need for Residential Relocation," "Level of Local Availability of Replacement Housing Facilities," and "Likelihood of Title Curative Actions," "Status of Environmental Clearance," "Status of Right-of-Way Map," "Frequency of Eminent Domain," "Right-of-Way and Utility Scope," and "Number of Parcels for Acquisition." Likewise, for estimating utility adjustment durations, the drivers deemed highly influential and important by the practitioners include "Dedication of Funds to the Project (R/W and Construction)," "Funding Limitations for the Project," "Have Subsurface Utility Engineering (SUE) Investigations been Performed," "Adjustment is Reimbursable Utility or Non-Reimbursable Utility," "Status of Environmental Clearance," "Status of Right-of-Way Map," "Right-of-Way and Utility Scope," "Number of Utilities Located in Private Easement," and "Responsiveness of Utility Companies to TxDOT Needs." These drivers should be considered key data points in RUDI because they can provide users with more duration ranges that can be useful in forecasting actual durations of R/W acquisition and utility adjustment on highway projects.

The study also revealed that further research is needed to maximize the benefits of the RUDI tool, although validating the study's findings was restricted due to a lack of data. Additional studies for improving the RUDI tool should focus both on collecting more recent data and reconstructing the tool in terms of function and structure.

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Chapter 1: Introduction

1.1 RESEARCH BACKGROUND

Delivering highway projects differs significantly from completing building projects in several ways (Waters 2000). One of the characteristics differentiating highway projects from other kinds of construction is that highway projects require securing the approval of federal, state, and private agencies for more than 200 major activities in highway project development (GAO 2002). Another significant characteristic is that there are various pre-construction activities, including planning and designing, which should be completed prior to the start of the actual construction of highway projects. According to many state Departments of Transportation (DOTs), timely delivery of such pre-construction activities is one of the key components of the success of highway projects (AASHTO 2004 and FHWA 1999).

Based on the importance of these pre-construction tasks, this research focuses on two activities among them, right-of-way (R/W) acquisition and utility adjustment. In general, R/W acquisition is defined as the overall process extending from the appraisal phase of the property on which the highway is to be built to the acquisition of that property. In addition, R/W acquisition can be divided into four phases: (1) the project scope development and design phase; (2) the appraisal and review phase; (3) the acquisition phase, and; (4) the adjustment or relocation of property phase (TxDOT R/W Manual 2006).

Similar to R/W acquisition, utility adjustment is also one of the key pre-construction activities in a highway project. An adjustment may involve facilities located on the highway right-of-way or partially on compensable properties held by the utility within the existing right-of-way (TxDOT Utility Manual 2006 and O'Connor et al. 2005). For these reasons, utility adjustment greatly depends on the R/W acquisition process and at the same time relates to other processes of highway projects.

These two pre-construction activities have been considered to be sensitive and important issues by most state Departments of Transportation because R/W acquisition and utility adjustment, which are integral processes that need to be completed prior to construction, can cause increased pressure for the R/W district personnel who need accurate information to make good estimates for avoiding cost and time overruns (O'Connor et al. 2005 and FHWA 1999). Moreover, recent studies have reported that most state DOTs have increasingly suffered from delays or conflicts related to R/W acquisition and utility adjustment (AASHTO 2004 and FHWA 1999). The Texas Department of Transportation (TxDOT) is no exception.

TxDOT has focused on the successful completion of R/W acquisition and utility adjustment processes because these can help ensure the timely delivery of highway projects. Specifically, the accurate forecasting of the amount of time required for R/W acquisition and utility adjustment has been considered one of the necessary skills of R/W districts in TxDOT, particularly in the planning phase. However, making such forecasts for these processes is both extremely challenging and complex because doing so requires a sophisticated understanding of the numerous factors involved in a highway project. Most R/W districts in TxDOT, moreover, have relied heavily on the experience of their staff such as administrators, appraisers, utility engineers, and so on. This reliance has meant that these districts have suffered from risks which are related to negative public opinion that results from project delays as well as adverse economic effects caused by the inaccuracy of duration estimations.

1.2 RESEARCH MOTIVATIONS AND NEEDS

While predictions about duration are necessary in delivering R/W acquisition and utility adjustment, their inaccuracy remains a major issue in TxDOT even though substantial efforts have been made to improve its capabilities in forecasting durations of these pre-construction processes. One of the recent studies conducted by TxDOT is Research Project 0-4617. This project identified the key drivers affecting durations of R/W acquisition and utility adjustment and also developed the Right-of-Way Acquisition and Utility Adjustment Duration Information Tool (RUDI) to help practitioners relying on their judgments better estimate these durations. However, predicted durations based on expert judgments often vary widely and thus are considered unreliable even when they are made using this tool. Moreover, there are still a number of drivers that should be considered in order to foster better forecasting durations of R/W acquisition and utility adjustment. These needs provided the motivation for this study.

This study comprises an implementation of the RUDI tool to identify any additional needs and make recommendations for improving the tool. In order to achieve this objective, it is necessary to beta-test the tool after providing its department members with adequate training. Because RUDI was developed to assist TxDOT R/W personnel in improving the planning and designing of highway projects, an implementation study is a key step in calibrating the tool and in recognizing future enhancements.

In addition, this study aims to obtain a more comprehensive understanding of the relationships among drivers affecting the durations of the R/W acquisition and utility adjustment and the accuracy of practitioners' predicted durations. To achieve this goal, additional drivers affecting the duration of R/W acquisition and utility adjustment processes need to be investigated, while practitioners' perceptions of the duration drivers needed in forecasting durations of these two processes should also be analyzed.

1.3 RESEARCH OBJECTIVES

The primary objective of this study was to understand how practitioners can better estimate durations needed for R/W acquisition and utility adjustment during the design/planning phase. Seven specific study objectives were established to achieve this main goal:

1) To evaluate the accuracy of the RUDI tool in order to see if RUDI is useful in improving the accuracy of duration estimation based on personal judgments of the R/W acquisition and utility adjustment.
2) To identify the duration drivers that need to be considered in predicting durations for R/W acquisition and utility adjustment.
3) To identify the drivers which distinguish more accurate from less accurate estimators through evaluating the importance of drivers.
4) To analyze associations among the accuracy of duration estimation and the perception of duration driver importance.
5) To analyze associations among practitioners' backgrounds and the accuracy of duration estimations.
6) To analyze associations among practitioners' backgrounds and the perception of duration driver importance.
7) To analyze the impact of highway project values on shifts between the importance assessments of duration drivers without specific information and the importance of duration driver with such information on highway project values.

1.4 RESEARCH HYPOTHESES

The following research hypotheses were determined to clarify the study's scope as well as its limitations. Three research hypotheses to be tested in this study include:

1) The importance of duration drivers, which are considered in predicting durations for R/W acquisition and utility adjustment, are perceived differently depending on practitioners' backgrounds including years of experience, areas of expertise, and types of districts with which practitioners are involved.
2) Practitioners' background areas are positively related to the accuracy of duration estimation for the R/W acquisition and utility adjustment processes. These relationships can be described in the following way:
    - The accuracy of R/W durations estimated by personnel specializing in R/W acquisition is greater than that for the durations predicted by utility adjustment practitioners.
    - Practitioners with many years of experience are better at predicting durations of R/W acquisition and utility adjustment than personnel with fewer years of experience.
3) There are differences among more accurate and less accurate estimators in perceiving the importance of duration drivers needed for R/W acquisition and utility adjustment.

1.5 RESEARCH SCOPE LIMITATIONS

This study included the following limitations:

1) The durations consisting of key milestones in the TxDOT R/W acquisition and utility adjustment processes were already identified from the previous

study (Project 0-4617). These identified durations were only analyzed in this study that was an implementation project for the TxDOT Project 0-4617.

2) The study used only a single completed TxDOT R/W project as a model project for data collection including duration estimation and duration importance assessment.
3) A very limited number of practitioners on R/W acquisition or utility adjustment in TxDOT were analyzed for this study because of excluding both R/W and utility staff at local county offices and outsources.
4) The study assumed that project basic facts-related duration drivers are commonly considered in determining durations of both R/W acquisition and utility adjustment processes.
5) In order to validate the study findings, two additional highway projects were utilized. However, due to the limited amount of data and the incompletion of these projects, only a descriptive statistical approach was applied as opposed to inferential statistics.

1.6 STRUCTURE OF DISSERTATION

This dissertation includes nine chapters. Following this introduction, Chapter 2 offers an overview of the implementation research methodology used to conduct this study. Chapter 3 reviews the development of the RUDI tool and introduces selected screen shots of the RUDI tool to facilitate an understanding of its interface. Chapter 4 summarizes the key existing literature of R/W acquisition and utility adjustment processes to contextualize this study's research within the field. Chapter 5 presents the tasks conducted to prepare for data collection. Chapter 6 describes the types of data collected in this study and the steps taken to collect them. Chapter 7 presents the impact of the RUDI tool on the accuracy of duration estimations for the R/W acquisition and utility adjustment processes, and it also summarizes the statistical analysis of the key duration drivers characterizing R/W acquisition and utility adjustment. Chapter 8 offers the results of the validation of the findings regarding influential drivers from the data analysis. Chapter 9 describes the findings that can be utilized in enhancing the RUDI tool. The findings include the drivers that should be additionally included in the RUDI tool and the list of suggestions available to reconstruct RUDI. Finally, Chapter 10 summarizes the study, offering conclusions and recommendations resulting from the study.

Chapter 2: Implementation Research Methodology

2.1 Overview of the Implementation Research Methodology

This chapter presents the methodology used to accomplish the study's objectives. Figure 2.1 illustrates the research process of this implementation study. First, the scope of this implementation study was defined using the results of the previous study, TxDOT Research Project 0-4617. Based on this scope, a literature review and a brief investigation of the RUDI tool were conducted. Second, a list of the duration drivers that affect duration of R/W acquisition and utility adjustment was created using expert opinion. Third, a Model Project Description Form (MPDF) characterizing a highway project was developed, and the research team provided RUDI training sessions to personnel in selected districts in TxDOT. Fourth, for the purposes of data collection, an assessment of the varied importance of duration drivers and estimation of durations were performed. Simultaneously, suggestions that can be useful in improving the RUDI tool were collected. Fifth, an analysis of the data was conducted, and the findings of the study were validated using additional data samples. Finally, based on all the collected data, conclusions were drawn and recommendations set forth. The sections that follow Figure 2.1 address the implementation research process in more detail.

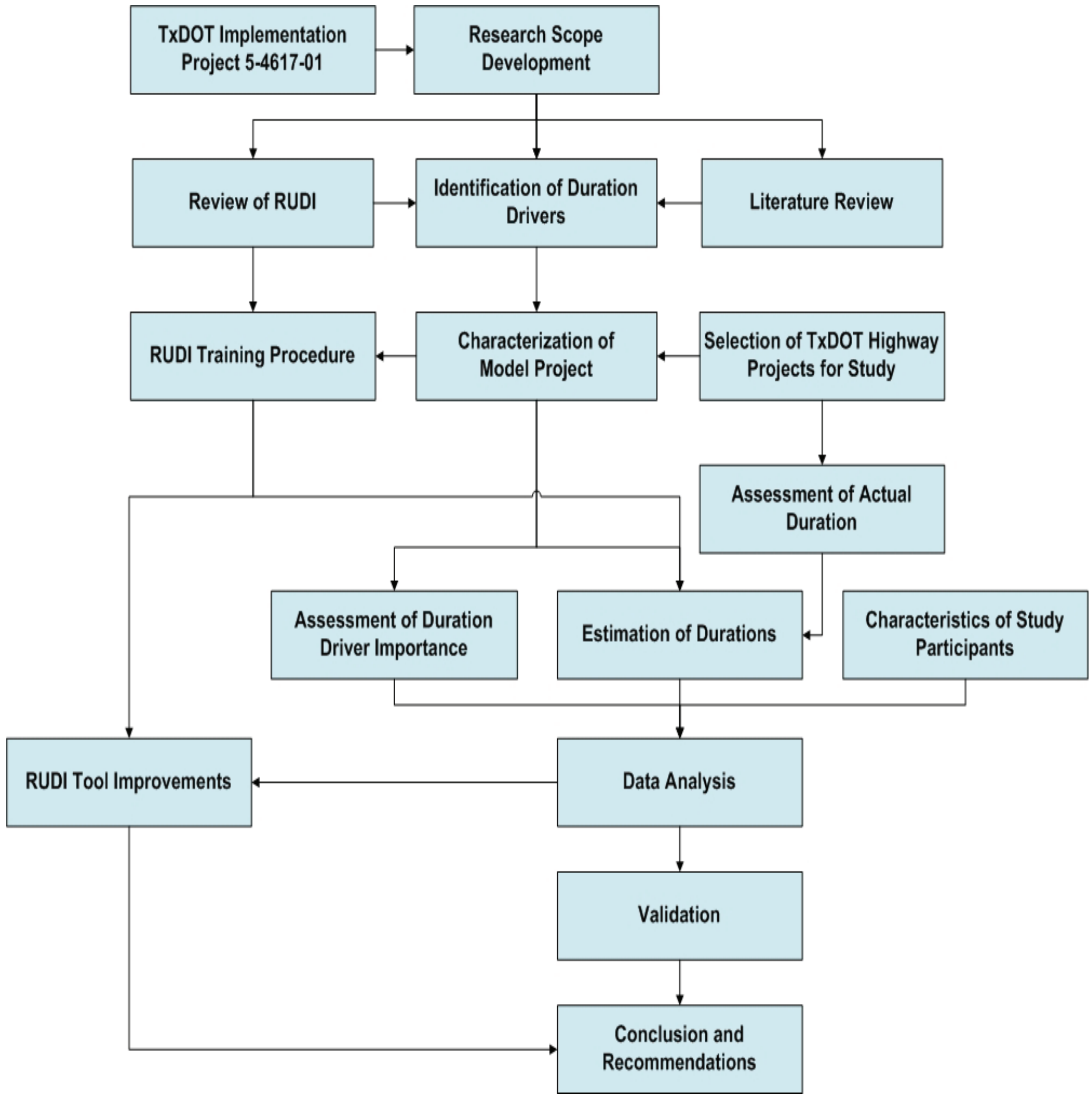


Figure 2.1: Implementation Research Methodology

2.2 REVIEW OF RUDI DEVELOPMENT

Chapter 3 describes the background of the Right-of-Way Acquisition and Utility Adjustment Duration Information Tool (RUDI) that was one of the accomplishments of Research Project 0-4617. To provide TxDOT personnel with key information about it, a brief overview of the development of the RUDI tool was undertaken in this study to expand upon the previous project. In addition, selected screen shots of the improved RUDI tool were introduced to show its overall structure as well as its key components.

2.3 LITERATURE REVIEW

Along with an overview of the RUDI development, a literature review was conducted. The extensive literature review of R/W acquisition and utility adjustment is important to enhance understanding of the importance of these activities in highway projects as well as their key milestones, ones that are considered critical by practitioners involved. In addition, the literature of the previous research efforts regarding the best management practices and strategies utilized for expediting these two pre-construction activities is also described. Finally, factors affecting the schedule of highway projects are presented. A literature review is described in Chapter 4.

2.4 PREPARATION FOR DATA COLLECTION

In order to collect data for the study, there were several tasks that needed to be undertaken. Through interviews with experienced R/W administrators, the 42 drivers affecting the duration of R/W acquisition and utility adjustment were identified, and then based on these drivers, a Model Project Description Form (MPDF) that could be used to characterize highway projects was developed. In addition, real highway projects were selected from the Right-of-Way Information System (ROWIS), a highway project database for TxDOT, for data collection. Finally, as mentioned in Chapter 1, the research team provided study participants with adequate information and knowledge about the RUDI tool.

2.5 DATA COLLECTION

The assessed data for this study were broken down into two categories: (1) the importance of duration drivers, and (2) the estimation of a project's duration. These two types of data were collected during RUDI workshops which were conducted with TxDOT R/W district office staff. First, study participants were asked to assess the pre-application importance of duration drivers as illustrated in Figure 2.2. Second, their personal judgments regarding duration estimation, which were defined as "Non-RUDI-based Estimation," were sought. After the non-RUDI-based duration estimation process, the research team provided district staff with RUDI training, and the duration estimation using RUDI was conducted. Finally, study participants were asked to evaluate the POST-application importance of the duration drivers. The detailed process of data collection and the type of data that was collected are described in Chapter 6.

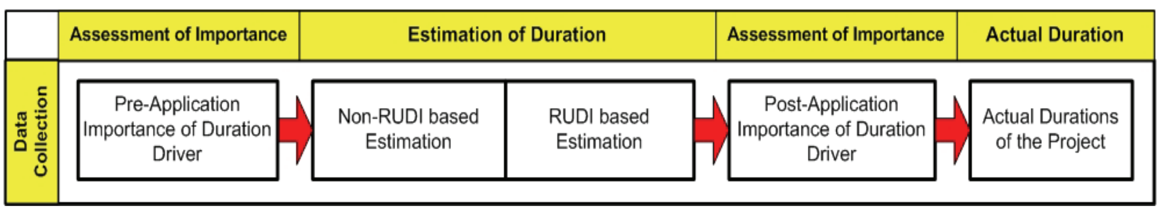


Figure 2.2: Overview of the Data Collection Process

2.6 FINDINGS ON DETERMINING DURATIONS FOR R/W ACQUISITION AND UTILITY ADJUSTMENT

The data analysis was divided into five sections: (1) the accuracy of duration estimation; (2) the importance of duration drivers; (3) the associations between the importance of the drivers and the accuracy of their estimations; (4) the relationships between the background factors of the practitioners and the accuracy of their duration estimations, and; (5) the impact of driver values on perception of the driver importance.

Specifically, the analysis of the importance of duration drivers was undertaken to identify which duration drivers are considered by experts to be the more and less important ones in predicting the durations of the R/W acquisition and utility adjustment processes. Based on different background factors such as areas of expertise, years of experience, and types of district, respondents' various perceptions of duration drivers' importance were also investigated. In order to isolate the drivers that need to be emphasized, two cut-off points were determined. For separating the most important drivers in the analysis of the PRE-application and POST-application importance assessments, a value of 0.8 was utilized. Along with this cut-off value, in the analysis showing differences, a value of 0.2 was set up.

Moreover, several relationships were analyzed in this study using different tests. In the analysis of the associations among accuracy of duration estimation, the relationships between duration estimation accuracy, and various personnel backgrounds, a chi-square test was used. A chi-square test is an effective method to test for the significance of relationships between variables cross-classified within a contingency table. Within such a test, analysts set up a null hypothesis stating that there is no relationship among the variables in the contingency table. If the null hypothesis is disproved, it means that the positive research hypothesis—the one saying that there is a statistically important relationship among the variables in the population from which the sample was collected—has been established. However, a chi-square test was not fully reliable for the analysis because the expected count was less than five in the contingency table due to a lack of samples. In order to overcome this limitation, a Fisher exact test, which is an alternative to the chi-square test, was applied. SPSS includes this alternative as one of the functions that users can choose in conducting a chi-square test. In addition, gamma and odds ratio were calculated to see if there is the directional relationship between variables and to measure an effect size for variables, respectively. The gamma is a non-parametric measure of associations that measures the strength of associations of ordinal data, while odds ratios are particularly useful in 2*2 contingency tables to calculate an effect size representing the strength of the relationships between two variables.

Along with the chi-square test, the McNemar's test was also used. This test, designed to test whether there is a statistically significant relationship among paired dichotomous categorical variables, was applied to analyze the impact of the project's values on the post-application importance assessment of duration drivers. The results of this step are summarized in Chapter 7. In this study, the SPSS (Statistical Package for the Social Sciences) was used for the data analysis. Chapter 7 also includes the drivers deemed to be most influential, that is, those with large differences among practitioners' assessments of their importance, for improving the accuracy of the duration estimation based on the application of RUDI.

2.7 Validation of Findings

For validating the findings regarding the drivers deemed to be most influential, two additional highway projects were selected and utilized to assess the importance of duration drivers described by the MPDF. Based on this form, respondents were asked to assess the importance of drivers characterizing the R/W acquisition and utility adjustment processes for two separate highway projects. However, due to a lack of funding, only the R/W acquisition processes of the selected highway projects have been included in this study, and utility adjustment processes have not been initiated. Therefore, the findings regarding the R/W acquisition process of the study were precisely re-tested using additional collected data samples. The details about this process are described in Chapter 8.

2.8 SUGGESTIONS FOR ENHANCING RUDI

Chapter 9 includes three suggestions for reconstructing the RUDI. First, the percentile range guidance matrix was revised for adjusting the duration ranges represented by each percentile range as compared to the original version, to improve the tool's estimation accuracy. Second, the drivers considered to be most influential were used as additional data points for both R/W acquisition and utility adjustment of RUDI. Finally, a revised RUDI application procedure based on the above two suggestions was offered.

2.9 CONCLUSIONS AND RECOMMENDATIONS

Chapter 10 summarizes the conclusions of the study, gives recommendations for future research, and illustrates the study's contributions. The conclusions include an identification of the most important drivers that should be considered in predicting the durations of R/W acquisition and utility adjustment in highway projects as well as other findings from the study. Several recommendations for future research are also described, and academic and practical contributions are presented in this chapter.

Chapter 3: Review of the Development of RUDI

3.1 BACKGROUND ON RESEARCH PROJECT 0-4617

In order to establish an effective methodology for predicting the duration of the R/W acquisition and utility adjustment processes, Research Project 0-4617 was initiated by TxDOT and was undertaken from 2005 to 2006. This project included a comprehensive review of the R/W acquisition and utility adjustment processes using TxDOT historical projects selected from the Right of Way Information System (ROWIS), which is currently being used as the main database system for R/W acquisition in TxDOT. For R/W acquisition durations, the 0-4617 original research studied 45 projects selected from ROWIS with approximately 720 parcels of land related to the completed projects. For the utility adjustment durations, 83 projects nominated by district officers were examined.

The principal findings from the 0-4617 research project included the key durations for the R/W acquisition and utility adjustment processes. These durations that needed to be predicted included a combination of five different milestones constituting the R/W acquisition and utility adjustment processes in a highway project. Table 3.1 defines these five key milestones which were expressed as dates corresponding to different project phases.

First, the Right-of-Way (R/W) Project Release is the earliest date that TxDOT officially initiates logging work hours on an R/W or utility adjustment project. Second, the Initial Appraisal indicates the earliest date of appraisal recorded by the R/W appraiser on the Real Estate Appraisal Report form. Third, the Possession of Parcel indicates either the latest date of completion of the Title Company's Closing Statement – State of

Texas form (ROW-N-72) or the latest date of deposit shown on the Notice of Deposit form (ROW-E-ND). Fourth, the Final Project Utility Adjustment Agreement Execution is the date that utility agreement was submitted to TxDOT. This date can be recorded on the Standard Utility Agreement form (ROW-U-35). Finally, the Final Project Utility Adjustment Completion indicates the date of completion of the utility adjustment in the field. This date can be found on the Utility Clearance Letter (ROW-U-CLEARANCE); however, it needs to be re-confirmed by investigating the actual completion date in the field. These documents that relate to the five key milestones are fully described in Appendix A.

Table 3.1: Five Key Milestones in R/W Acquisition and Utility Adjustment Processes

Milestone	Definition
1. Right-of-Way (R/W) Project Release	The earliest date that TxDOT can officially begin logging work hours on a R/W or Utility Adjustment Project
2. Initial Appraisal	The earliest appraisal date recorded by the appraiser on the Real Estate Appraisal Report (TxDOT form ROW-A-5 & ROW-A-6)
3. Possession of Parcel	Either the latest date of completion of ROW-N-72 or the latest date of deposit shown on ROW-E-ND
4. Final Project Utility Adjustment Agreement Execution	The date of the submitted utility agreement with TxDOT (ROW-U-35)
5. Final Project Utility Adjustment Completion	The date of completion of the final project utility adjustment in the field (ROW-U-CLEARANCE)

The durations for R/W acquisition, which are based on the key milestones identified above, were divided into three key segments: R1, R2, and R3, which are described in Figure 3.1. R1 represents R/W Project Release to Initial Appraisal, R2 represents Initial Appraisal to Possession of Parcel, and R3 represents R/W Project Release to Possession of Parcel. In other words, R3 indicates the entire process of R/W acquisition. There are also three segment durations which are divided in a similar way for utility adjustment: U1, U2, and U3. U1 is defined as the duration from R/W Project Release to Final Project Utility Adjustment Agreement Execution. U2 represents Final Project Utility Adjustment Agreement Execution to Final Project Utility Adjustment Completion. U3 represents R/W Project Release to Final Project Utility Adjustment Completion. So again, U3 includes the durations covered by U1 and U2. Figure 3.1 depicts these six durations graphically.

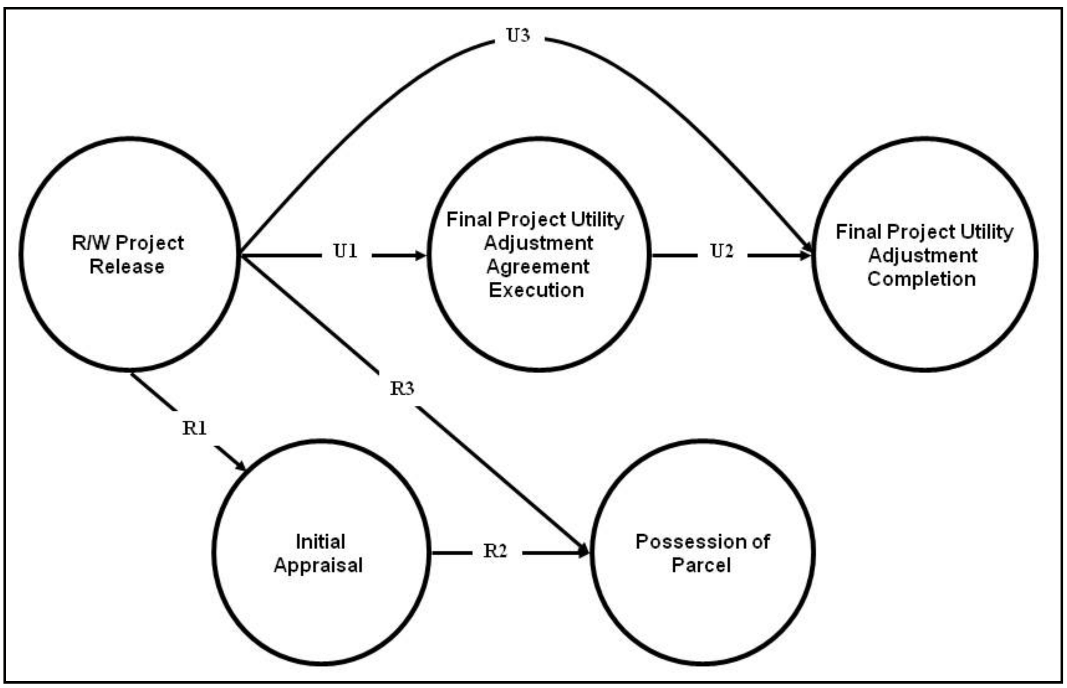


Figure 3.1: Key Milestones in R/W Acquisition and Utility Adjustment Processes

Based on these six durations, four major factors that should be considered for R/W acquisition and eight main factors for utility adjustment were identified in Research Project 0-4617. For the R/W acquisition durations, “Number of Parcels,” “Location Type,” “District R/W Staff Size,” and “District Annual R/W Budget” were identified as key drivers. In contrast, the eight factors for utility adjustment included “TxDOT

Highway Type," "TxDOT Project Type," "Utility Type," "Reimbursable or Non-Reimbursable," "LPA-Funded or Non-LPA-Funded," "Federally-Funded or Non-Federally-Funded," "Location Type," and "Quick or Slow." These key factors were used as the principal components of the Right-of-Way Acquisition and Utility Adjustment Process Duration Information (RUDI) tool, and they are described in the following section.

3.2 OVERVIEW OF RUDI

One of the accomplishments achieved during the Research Project 0-4617 was the development of the Right-of-Way Acquisition and Utility Adjustment Process Duration Information (RUDI) tool. This tool assists in decision-making by enhancing TxDOT's capability to predict the duration of the R/W acquisition and utility adjustment processes in a given highway construction process. RUDI provides statistical information on selected TxDOT historical highway projects using cumulative plots and percentage tallies for the main factors for R/W acquisition and utility adjustment processes. These factors include those identified as the key drivers for R/W acquisition and utility adjustment in the previous section. The following sections describe the structure of RUDI and the procedure of the tool application in more detail based on the user guide included in the tool (O'Connor et al. 2005).

3.2.1 Structure of RUDI

As depicted in Figure 3.2, the six components of the RUDI tool are as follow: advisory data (both R/W acquisition and utility adjustment durations), project duration record forms, an integrated process map, a key process milestone form, and the RUDI user guide. The user can access these components directly on the main RUDI interface page. There are six primary buttons on this main interface page corresponding to each of the main components and two buttons that allow the user to exit the system and to find information about the research that went into RUDI's design. The main RUDI interface is illustrated in Figure 3.2.

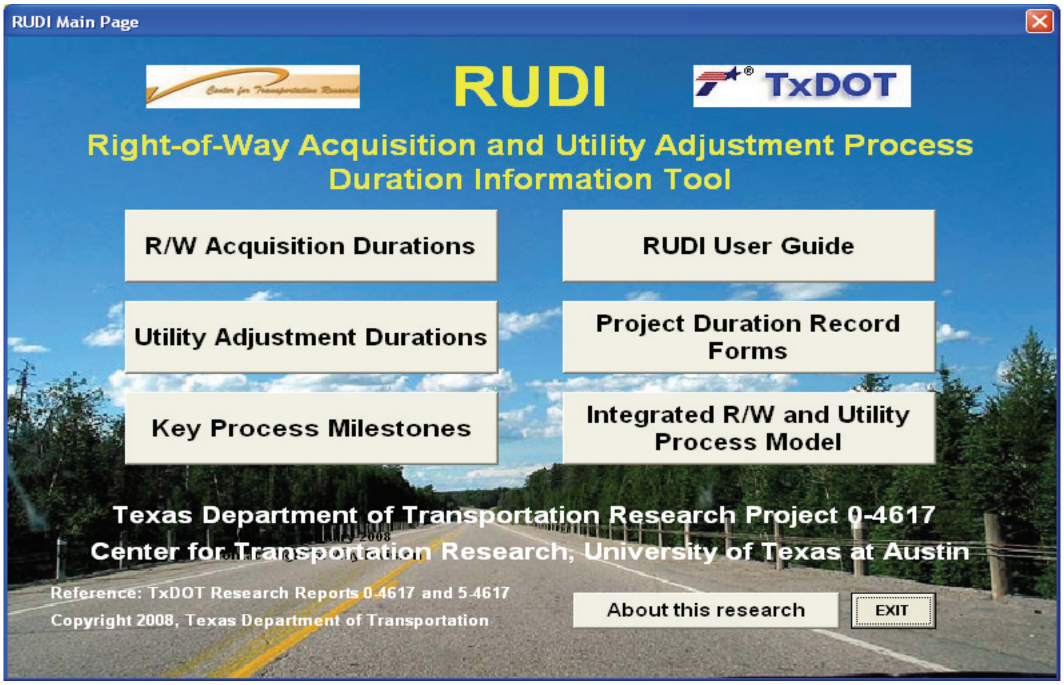


Figure 3.2: Main Interface of RUDI

3.2.1.1 R/W Acquisition Durations

The R/W Acquisition Durations button on the main interface described in Figure 3.2 takes the user to the R/W acquisition duration information page. As illustrated in Figure 3.3, the R/W Acquisition Durations window displays three durations: R1, R2, and R3, which correspond to various duration measurements in the R/W acquisition process as explained earlier. Statistical information about each of the durations that need to be predicted can be found by clicking on any duration buttons.

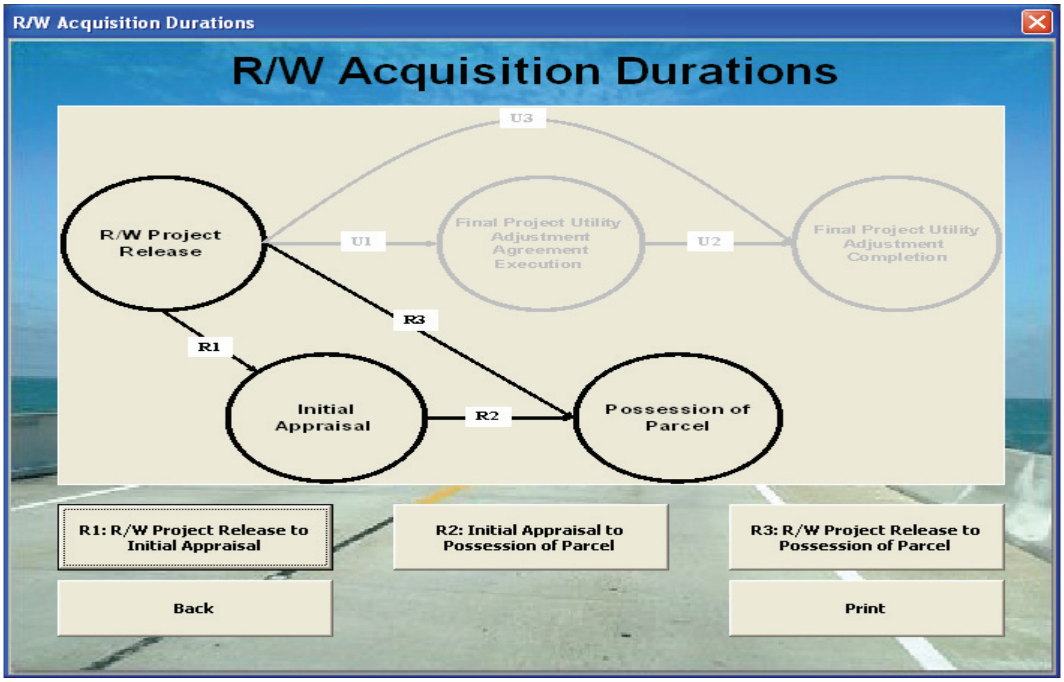


Figure 3.3: R/W Acquisition Process Durations

As depicted in Figure 3.4, the user can have access to another window showing the key factors for the R1 duration by clicking the R1 duration button on the R/W acquisition durations window. The key drivers include ‘number of parcels,’ ‘location type,’ ‘district R/W staff size,’ and ‘district annual R/W budget,’ as mentioned earlier in this section. Each factor has optional values that can provide more specific data relevant to the desired duration. In this way, data gathered from completed projects can be mined for making estimates about new projects. The user can see a similar window when selecting the R2 or R3 duration.

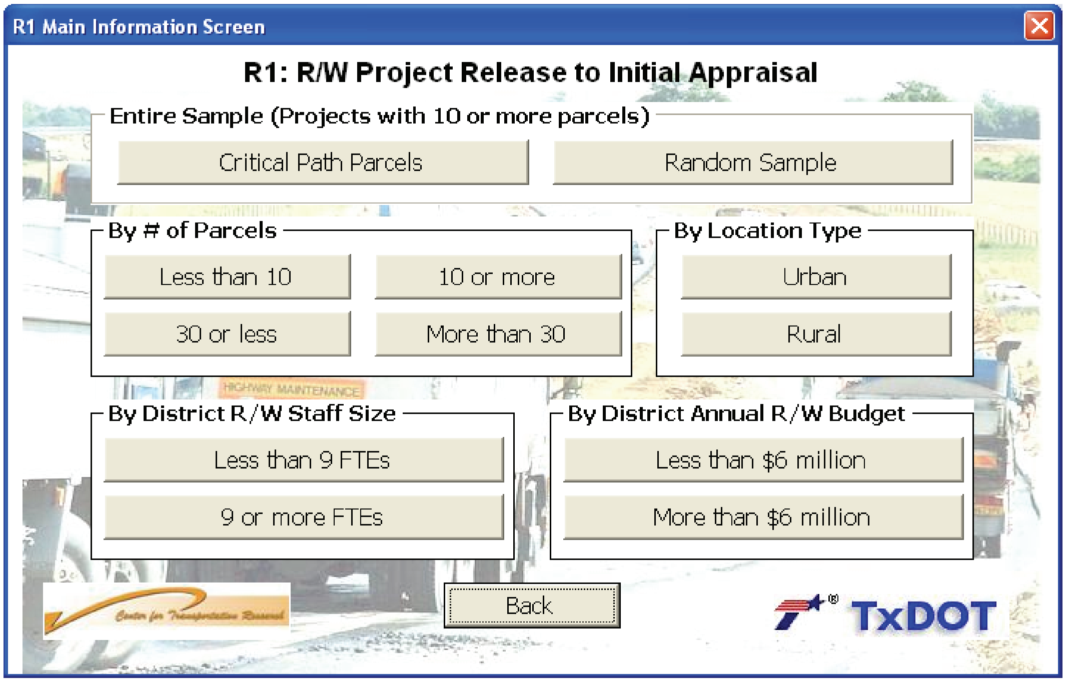


Figure 3.4: Key Drivers of R/W Acquisition Process Durations

3.2.1.2 Utility Adjustment Durations

Similar to the R/W acquisition durations, the Utility Adjustment Durations button on the main interface of RUDI leads the user to the utility adjustment durations information window. In addition, there are three durations including U1, U2, and U3, as shown in Figure 3.5.

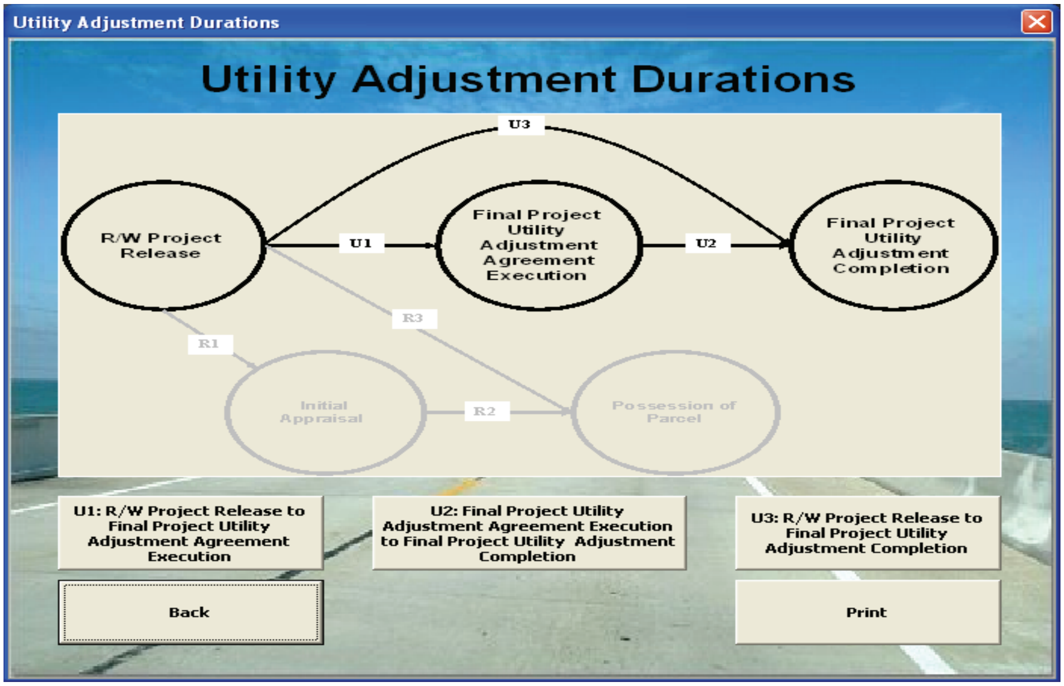


Figure 3.5: Utility Adjustment Process Durations

The RUDI tool provides information about eight factors that need to be considered in predicting the utility adjustment durations. Figure 3.6 illustrates the window that is used to predict the U1 duration which is defined as the duration from R/W Project Release to Final Project Utility Adjustment Agreement Execution. Similar to the R/W selection process, users can utilize these factors relevant to their projects. For example, if the project is not LPA-funded, the user can click on the "Non-LPA-Funded" button to access information of interest for that kind of project, and the user can choose whether he or she wants to see the data in either graphical or statistical format. A similar window is presented for depicting the U2 and U3 duration factors.

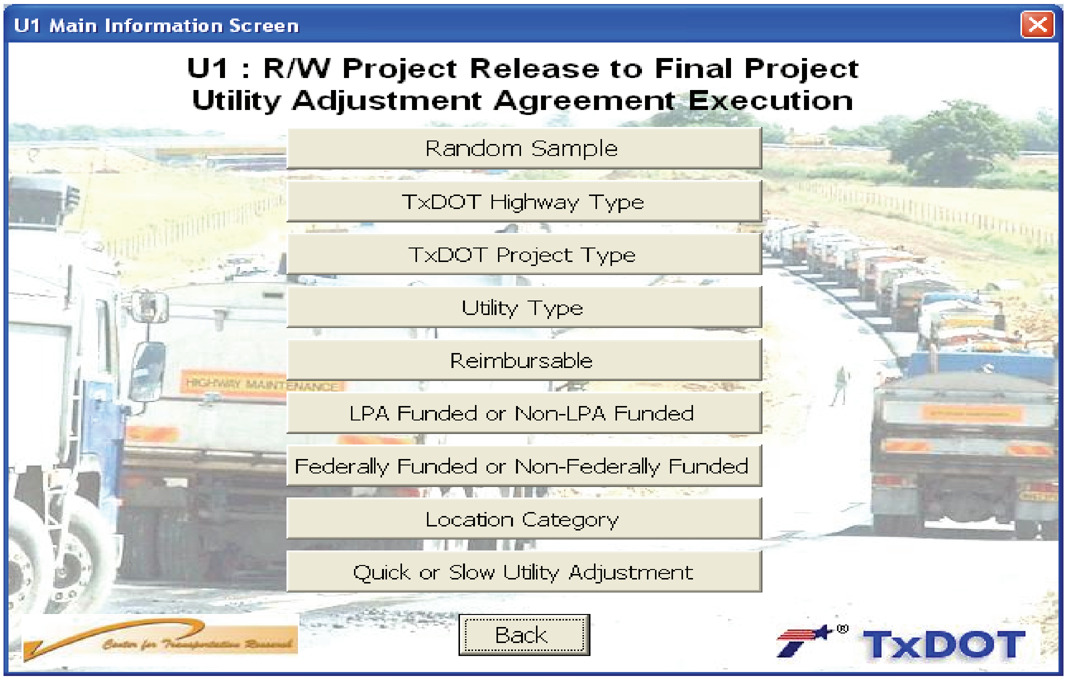


Figure 3.6: Key Drivers of Utility Adjustment Process Durations

The user also has access to the duration data, which are presented in two different formats: graphical plots and statistical information, as depicted in Figure 3.7. Each graph represents a plot illustrating cumulative percentiles of project time (calendar days) for each of the durations in R/W acquisition. The accompanying descriptive statistics present the plot information in more detail. These data are indicated in both a statistical summary table and a percentile table. The first table shows the statistical mean, standard deviation, and minimum and maximum values of the past durations, while the second table shows the range of percentiles of these same data. For the U1, U2, and U3, users can see similar windows showing statistical information about the eight factors relevant to the utility adjustment durations.

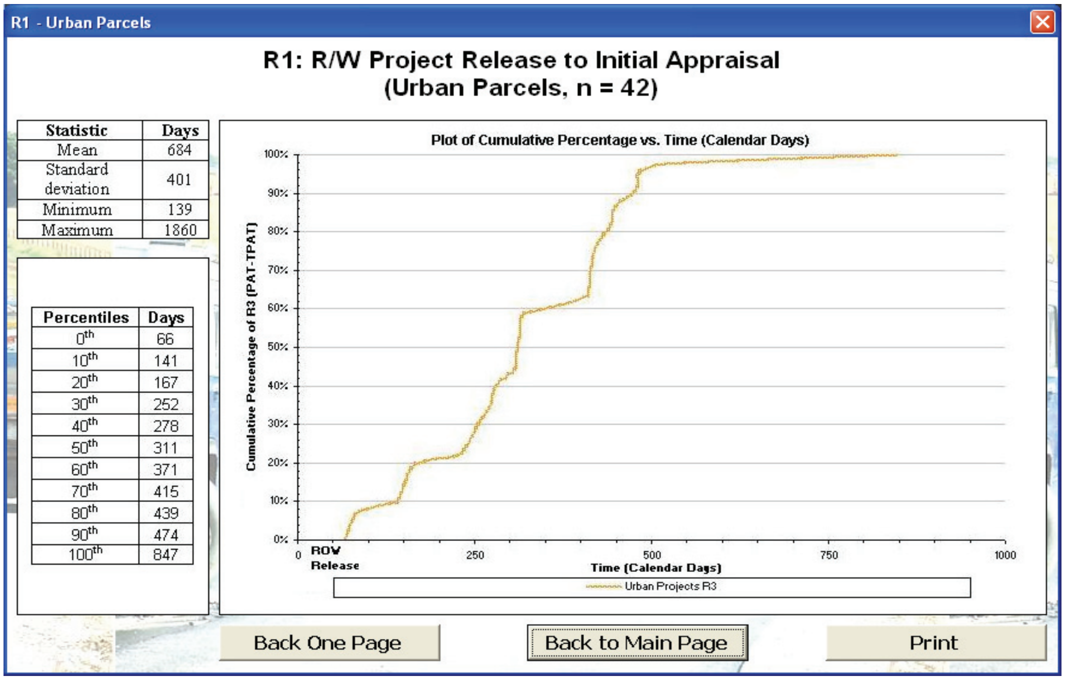


Figure 3.7: Output of RUDI

3.2.1.3 Key Process Milestones

The Key Process Milestones button takes the user to a plot of the process milestones that represent the project's target dates for R/W acquisitions and utility adjustments, as described in Figure 3.8. Such milestone information can help the user to understand what each duration means in this tool. Moreover, it is a form that can be used to help the user understand the critical paths of the R/W and utility adjustment processes, thus making it easier to visualize the overall process of R/W acquisition and utility adjustment in highway projects.

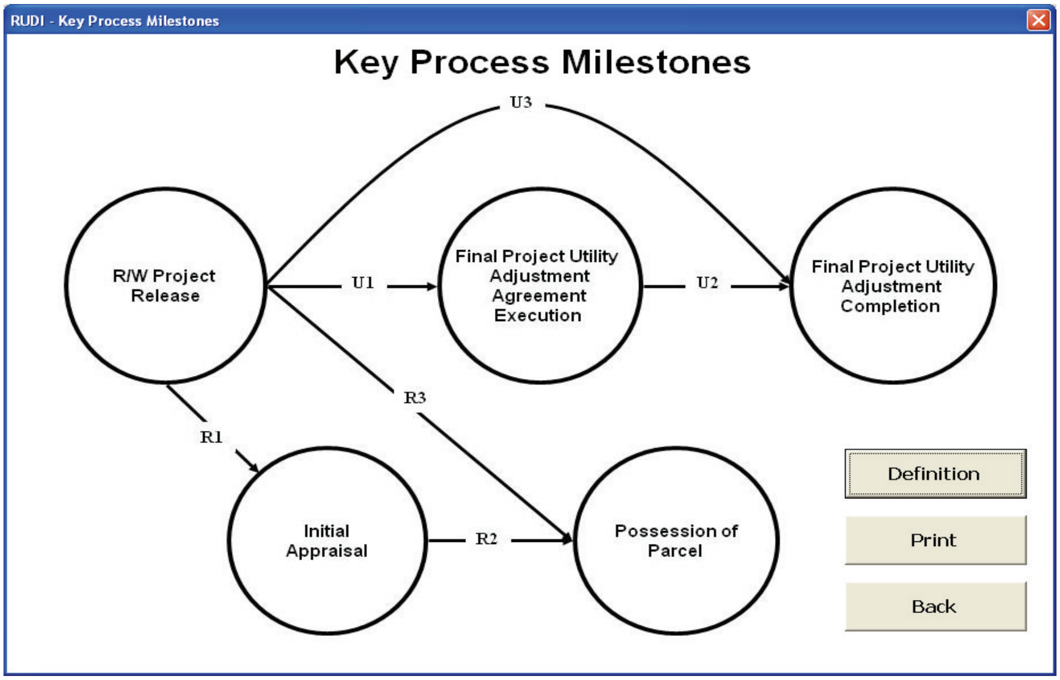


Figure 3.8: Key Process Milestones in RUDI

3.2.2 Percentile Range Guidance Matrix

A key decision a user needs to make with RUDI involves selecting a percentile range. To help guide the user, a percentile range guidance matrix, which the research team developed, is provided. This guidance matrix provides the user with appropriate percentile ranges based on two variables affecting highway projects: the degree of uncertainty and the degree of schedule urgency.

Both variables have three categories that represent three levels of urgency and uncertainty: low, moderate and high. Schedule urgency is determined by the conditions affecting the project schedule and other duration factors. As shown in Table 3.2, the higher the level of schedule urgency, the lower the recommended values of the percentile range. Conversely, the uncertainty levels are determined by factors that affect the R/W acquisition and utility adjustment durations. As presented in the matrix, the higher the degree of uncertainty, the higher the values of the percentile range. The question of whether to select schedule urgency or level of uncertainty is left to the user to answer, and this answer may depend upon the project under consideration. The "Project Duration Record Forms" button on the main interface page takes the user to this matrix.

Table 3.2: Original Percentile Range Guidance Matrix

		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
	Moderate	30-50	30-60	30-70
	Low	50-70	50-80	50-90

The information described in this chapter are the crucial components of the RUDI tool for predicting the durations of the R/W acquisition and utility adjustment in highway projects. Since understanding the mechanism of RUDI is the first step to prepare for the data collection for this study, this chapter was provided as a user guide in the final summary report for TxDOT.

Chapter 4: Literature Review

The existing literature provided the background information needed for understanding the importance of R/W acquisition and utility adjustment in highway projects and for identifying potential key factors that affect these two pre-construction processes. This literature can be broken down into three sections which provide this chapter's structure. The discussion in the first section includes the characteristics and importance of the R/W acquisition and utility adjustment processes. The second section provides a summary of the various best practices used by many state DOTs for expediting these two pre-construction processes. In the third section, the literature about factors that affect the schedule of highway projects is summarized.

4.1 R/W Acquisition and Utility Adjustment Processes on Highway Projects

The United States General Accounting Office (GAO 2002) reports that while the time required for delivering a highway project varies depending upon its complexity and size, it typically takes from nine to 19 years to make a plan, obtain approvals, and construct major new highways. In addition, a single highway project can involve as many as 200 major activities that need to be effectively coordinated in order to avoid delays and conflicts. Such delays and conflicts can make highway construction time-consuming (GAO 2002).

Among these major activities, Right-of-Way (R/W) acquisition and utility adjustment are considered critical pre-construction processes in a highway project, and these are precisely the factors that distinguish delivering highway projects from completing building projects (TxDOT 2006). These pre-construction processes require a considerable number of approvals from a number of agencies or other stakeholders involved in the project, and this approval process frequently requires more time than the original project schedule had accounted for (Waters 2000). Therefore, the timely completion of the R/W acquisition and utility adjustment processes has been recognized as a key component to the successful delivery of highway projects by most state DOTs (AASHTO 2004 and 1994).

In general, R/W acquisition is defined as the overall processes from the appraisal of the property for construction to the acquisition of the property (TxDOT 2000) and can be divided into four phases: (1) the scope development and design phase; (2) the appraisal and review; (3) the acquisition of the property, and; (4) the adjustment or relocation of the property.

Conventionally, the scope development and design of the R/W acquisition process initiates right after Environmental and precedes Plans, Specifications, and Estimates (PS&E) development and construction letting (O'Connor et al. 2005 and TxDOT 2003). However, the R/W acquisition process often needs to be started during preliminary data collection before the preceding items are completed. That is, the project scope development and design phase of R/W acquisition could include the preliminary data collection activities, though the R/W acquisition process officially begins once the districts start acquiring property for construction (TxDOT 2003 and 2006a). Therefore, this phase includes the identification of any unusual circumstances surrounding the project and the staffing requirements for delivering the project.

The second phase of the R/W acquisition process includes all of the activities required for appraising the property and for reviewing the appraisal that at that point would have been offered to the property owner. A detailed appraisal and review process prepared by the various agencies involved in acquiring real property should reflect national appraisal and review standards, including the Uniform Standard Practices for Appraisal Professionals (USPAP) and the Uniform Appraisal Standards for Federal Land Acquisition (UASFLA) (O'Connor et al. 2005 and TxDOT 2003).

The third phase is negotiations with the property owner, and these begin immediately after the property has been appraised and the amount of compensation for the property to be offered the owner has been determined. Providing informational documentation about the property appraisal results is necessary in order to effectively negotiate with the property owner. After negotiations are completed, the property owner then signs all of the required documents that should be submitted to TxDOT prior to the start of relocation or adjustment (TxDOT 2003 and 2006a).

Finally, relocation or adjustment assistance is provided to the owners who have possible structures or buildings on the property that need to be relocated or adjusted. According to the Real Estimate Acquisition Guide (FHWA 2006), this relocation and adjustment process are completed by: (1) providing all of the required information regarding relocation, including eligibility for relocation and the time of evacuation; (2) assisting property owners who have to vacate their properties, and (3) making payments to the owners or residents (TxDOT 2003 and 2006a).

Similar to R/W acquisition, utility adjustment is also one of the key pre-construction processes in a highway project. This process includes all of the activities for adjusting or relocating utilities or facilities that affect the property and is closely related to the R/W acquisition process (TxDOT 2003 and 2006b). Therefore, it is not unusual that problems with utility-related delays can lead to schedule overruns and added project costs (Ellis 2005 and FHWA 2002). Due to these problematic characteristics, improvements in utility adjustment have been emphasized by many state DOTs because these entities wish to avoid delays and conflicts (Ellis 2005 and AASHTO 2004).

Other government agencies have studied these problems. The United States General Accounting Office (GAO) has investigated the causes of utility adjustment-related conflicts on highway projects. The most commonly cited causes include inadequate time allowances for project planning and design, lack of coordination between all disciplines, lack of resources for utility work, and low quality information about related utility locations. Among these causes, a lack of coordination and communication between the disciplines involved along with a lack of information on the existing utilities within the R/W were recognized as the major causes for most delays and conflicts (GAO 1999).

Another recent study indicates that expediting utility adjustment is one method that can positively impact the overall project delivery time (Gibson 2002). In order to alleviate utility-related delays and expedite the adjustment of utilities, various approaches have been implemented by state DOTs. These approaches are described in more detail in the following section.

4.2 STRATEGIES FOR EXPEDITING R/W ACQUISITION AND UTILITY ADJUSTMENT

It is not an easy task to manage efficiently all of the activities for the successful delivery of R/W acquisition because there are a number of challenges that can be fraught with uncertainty and thus can cause conflicts or delays. Many state DOTs, therefore, are increasingly focusing on utilizing management strategies and practices that can facilitate acquiring property and expediting the whole acquisition process.

First, a multi-disciplinary team that can be involved from the initial phase of the R/W acquisition through the completion of the project have been employed by several state DOTs (TRB 2000). This practice requires the earlier involvement of multiple disciplinary representatives such as R/W appraisers and other R/W acquisition-related staff members. Such personnel can provide knowledge and expertise about environmental issues and costs of the property. Another beneficial practice during this phase is to involve the property owners early in the R/W acquisition process (AASHTO 2004 and TRB 2000). This involvement enables the owners to present their potential concerns related to the acquisition and allows for better communication and coordination with the DOT team. Moreover, this proactive strategy can be effective in reducing the occurrence of eminent domain proceedings due to R/W-related conflicts (FHWA 2002).

Second, having a single person that handle appraisal and negotiation functions has proven useful in ensuring consistency in communication between the property owner and the agent, which is important in the acquisition process (AASHTO 2004 and TRB 2000). This practice was originally initiated in several European countries, including Norway, Germany, and England. In the United States, the California DOT utilized a single appraiser/negotiator for acquisition and adjustment activities in order to provide improved service to the owners of the affected properties and to save significant operational and schedule costs (FHWA 2002). Maintaining a pool of qualified appraisers, utilizing a variety of delivery incentives, and reducing paperwork through electronic technology are needed to maximize the benefits of a single staff for appraisal and negotiation (FHWA 2002).

Third, streamlining the processes related to acquisition and relocation has been a critical concept for saving delivery time and costs of acquisition. The Florida DOT has implemented appraisal waivers that extend up to a limit of $10,000 based on appraiser estimates that are not included in construction contracts. In addition to appraisal waivers, a waiver of federal requirements has been considered by European countries for streamlining the relocation process. The concept of land consolidation used in Norway involves acquiring and rearranging land for fair distribution among remaining landowners for improving accessibility to their properties (AASHTO 2004 and TRB 2000).

Finally, many studies indicate that R/W staff training can reduce the R/W delivery time by more than six months. The survey taken by the National Cooperation Highway Research Program shows that staff training is the most useful method for expediting the R/W acquisition process and saving delivery time and costs (FHWA 2002 and TRB 2000). Therefore, formal training for R/W professionals, who should understand the key principles and practices from the initial appraisal phase of property to the acquisition of property, is critical.

For expediting utility adjustment, there are also various practices used by many state DOTs. The following paragraphs describe the most common strategies and practices. First, Subsurface Utility Engineering (SUE), which is defined as an engineering process for identifying the quality of the subsurface utility information within the R/W that is necessary for construction, is the most commonly cited practice. Collecting information about the locations of existing utilities through SUE has proven to be useful in mapping the utilities that need to be adjusted or relocated. By using SUE in highway project planning and design, highway planners can also avoid difficulties in obtaining reliable information on subsurface utilities (TxDOT 2006b and Ellis 2005). Other than SUE, Computer-Aided Design and Drafting (CADD) and the Geographical Information System (GIS) are recommended by many state DOTs as among the best practices for enhancing utility adjustment (Ellis 2005).

Second, by including utility adjustments in the construction contract, DOTs can allow the contractor enough flexibility to expedite utility adjustment activities. This arrangement has also been implemented to help the construction contractor improve coordinate adjustments with utility companies. In Germany, utility agreements between a project's authorizing entity and utility companies have been used to better control work and to prevent delays and disruptions in adjusting utilities (Ellis 2005 and TRB 2000).

Finally, the early participation of utility companies in the R/W design phase is highly encouraged by many state DOTs for establishing contact with the key practitioners and verifying the utility's physical adjustment plans (Ellis 2005).

As described in this section, a number of best practices and strategies have been utilized by many DOTs and several European countries, and then have proved to be useful in reducing the delivery time and costs of R/W acquisition. However, because some guidelines are only effective when they are implemented in selected locations and projects, it is necessary to identify unique circumstances that can have impacts on the application of those practices and strategies.

4.3 FACTORS AFFECTING THE SCHEDULE OF HIGHWAY PROJECTS

According to studies conducted by Sukumaran et al. (2006) and Iyer et al. (2006), various factors affect the scheduling of highway projects. The researchers conducted the study to identify the factors that affect such project scheduling and also to evaluate their impact on project duration. Based on the results of the study, the factors were grouped into three categories including DOT criteria, user criteria, and contractor criteria.

First, DOT criteria include political, legal, financial, traffic, and project ones. The factors relating to the category of political criteria include political events, additional funds made by a political institution/individual, or interest groups. These specific factors could have a probable impact on not only construction schedule and budget, but also on contractual agreements (Forekenbrock et al. 1990). State-specific local ordinances and restrictions were identified as legal factors that impose schedule changes and impact construction activities of the project. Additional costs used by the agency for supervision and quality control were considered financial factors. The category of traffic criteria included traffic parameters and safety issues (Blincoe 1996). The types of contracts and highway characteristics were included in the category of project criteria. All of the factors above are important for state DOTs in scheduling all activities that need to be delivered on time.

Second, the category of user criteria was grouped into four subcategories such as travel, safety, and public highway users. For road users, monetary losses caused by considerable delays in highway construction zones are an important issue. In addition, increases in travel time are also considered as among the factors relating to user criteria. Deteriorating air quality, increasing congestion, and high levels of noise from construction are all included in the category of safety criteria (Mahmassani and Jayakrishnan 1988). Furthermore, users influenced by construction activities consider longer commute times resulting in longer work days, lost opportunities for work and recreation, and a potential decrease in property values due to construction activities to be significant factors.

Lastly, the category of contractor criteria includes concerns for workers, resources, and projects. Specifically, the important factors regarding workers are safety, morale, and productivity (Blincoe 1996). The contractors considered staffing requirements, material supply plans, equipment maintenance, and weather conditions as the factors relating to the resource criteria. Similar to the DOTs' criteria, the factors including type of contract, project type, and project location were recognized from a perspective of project characteristics as the most important.

Some of the factors described in this section can be deemed to be significant in delivering highway projects that require the completion of pre-construction tasks such as R/W acquisition, utility adjustment, and relocation of facilities on the land. Moreover, since those factors can also be represented in major characteristics of highway projects, this study utilized them as the drivers that may affect the durations of the R/W acquisition and utility adjustment processes in highway projects.

Chapter 5: Preparation for Data Collection

5.1 Identification of Duration Drivers

In this research, the first step for preparing for the data collection was to identify a list of drivers that may affect the durations of the R/W acquisition and utility adjustment process. This step was necessary because the key drivers embedded in the RUDI tool as it is do not represent all characteristics of these pre-construction processes on highway projects. Even though the drivers that were already utilized in RUDI as key information have strong associations with R/W acquisition and utility adjustment, analyzing other characteristics of a highway project was a critical step in this implementation study.

The research team conducted a comprehensive review of relevant literature and then employed this expert opinion in order to identify these other key drivers. These identified duration drivers were categorized into three groups: (1) Project Basic Facts-related; (2) R/W Acquisition-related, and; (3) Utility Adjustment-related.

As illustrated by Table 5.1, there are 18 duration drivers related to Project's Basic Facts. Specifically, drivers #1 (TxDOT Project Type) to #3 (Project Location Type) present project and location types, and drivers #5 (Status of Schematic Design) to #8 (Status of Right-of-Way Map) are relevant to the status of the preliminary design phase of highway projects. In addition, there are drivers for project funds (#11: Dedication of Funds to the Project – R/W and Construction to #14: Funding Limitations for the Project) and conditions regarding R/W district (#9: Internal R/W Staff Size of a District and #10: District R/W Annual Budget). Drivers #15 (Level of Acceptance of the Project by the Public) to #17 (Common Concerns of Property Owners) describe external factors affecting both R/W acquisition and utility adjustment. These drivers were identified as common ones that may have an influence on the durations of both R/W acquisition and utility adjustment.

For R/W Acquisition-related drivers, 15 drivers were identified. These drivers can be divided into external and internal drivers because some information can be obtained through investigating external conditions of the project or district, while others, the internal ones, are determined by the nature of the project itself. So, following this schema, external drivers include #21 (Frequency of Eminent Domain), #26 (Level of Familiarity with Key Landowners), #32 (Likelihood of Title Curative Actions), and #33 (Responsiveness of Local Title Companies to TxDOT) because extenuating information can be obtained as the project proceeds. Drivers #19, #20, #22, #23, #24, #25, #27, #28, #29, #30, and #31 can be considered internal drivers because information can be gathered about them before the project begins.

For utility adjustment duration, there are nine drivers (#34 to #42) as illustrated by Table 5.1. All these drivers can be considered external ones because specific information about them can be identified by checking the physical conditions surrounding a highway project and the TxDOT regional districts.

Based on these drivers, the research team developed a form that can be used to characterize a highway project. That form is partially described in the following section. All 42 duration drivers described in Table 5.1 were assessed by R/W and utility experts in order to determine their levels of importance in duration estimation and to investigate their associations with duration estimation accuracy. The results of these analyses are described in Chapter 7.

Table 5.1: List of 42 Duration Drivers

Project Basic Facts-related Drivers	1. TxDOT Project Type 2. TxDOT Highway Type 3. Project Location Type 4. Right-of-Way and Utility Scope 5. Status of Schematic Design 6. Status of Boundary Surveying 7. Status of Environmental Clearance 8. Status of Right-of-Way Map 9. Internal R/W Staff Size of a District	10. District R/W Annual Budget 11. Dedication of Funds to the Project (R/W and Construction) 12. LPA Funded or Non-LPA Funded 13. Federally Funded or Non-Federally Funded 14. Funding Limitations for the Project 15. Level of Acceptance of the Project by the Public 16. Level of Political Pressure 17. Common Concerns of Property Owners 18. Current Status of the R/W Project
R/W Acquisition-related Drivers	19. Number of Parcels for Acquisition 20. Different Types of Parcel Usages 21. Frequency of Eminent Domain 22. Source of Personnel to be used for R/W Acquisition 23. Availability of District R/W Appraisers (District Staff and Outsourced) 24. Is Funding Available for Outsourcing Staff Assistance? 25. Type of Property Owners 26. Level of Familiarity with Key Landowners	27. Are There Any Property Tenants to Consider? 28. Need for Residential Relocation 29. Level of Local Availability of Replacement Housing Facilities 30. Need for Business Relocation 31. Level of Local Availability of Replacement Business Facilities 32. Likelihood of Title Curative Actions 33. Responsiveness of Local Title Companies to TxDOT
Utility Adjustment-related Drivers	34. Have SUE Investigations been Performed? 35. Will SUE Investigations be Performed? (If no or unknown in the driver #34) 36. Utility Type 37. Number of Utilities Located in Public R/W 38. Number of Utilities Located in Private Easement	39. Number of Utilities for Adjustments or Relocations 40. Is there any Utility Adjustment to be Included in the Highway Construction Contract? 41. Responsiveness of Utility Companies to TxDOT Needs 42. Adjustment is Reimbursable Utility or Non-Reimbursable Utility

5.2 Model Project Description

In order to present the identified 42 duration drivers effectively and make them more useful, a form, which is called the Model Project Description Form (MPDF), was developed. This form was designed to characterize an actual TxDOT project for both non-RUDI-based and RUDI-based duration estimation practices as illustrated in Figures 5.1, 5.2, and 5.3 in the following section. In addition, MPDF can be used by TxDOT project planners and R/W personnel in collecting the information needed to understand R/W acquisition and utility adjustment on highway projects. The full version of this document is described in Appendix B. The following section presents the informational elements of the form and instructions on its application in forecasting durations of R/W acquisition and utility adjustment in more detail.

5.2.1 Informational Elements

In this section, the components of the MPDF are described in detail. The form includes two columns for the title of the duration drivers and their optional values as illustrated in Figures 5.1, 5.2, and 5.3. Each driver includes a possible list of values, which designates specific information about the drivers.

5.2.1.1 Project Basic Facts-related Drivers

Figure 5.1 shows that eight drivers out of the 15 drivers related to project basic facts and their possible values. The first three drivers include information on TxDOT project type, TxDOT highway type, and project location. There are 14 different project types that TxDOT had completed or is currently delivering. For the TxDOT highway type, six respective types have been identified: (1) interstate; (2) state highway; (3) farm to market road; (4) city street; (5) US highway, and; (6) ranch to market road. Lastly, the possible project locations include rural, urban, and metropolitan areas.

Driver #4, Right-of-Way and Utility Scope, indicates whether a highway project requires both R/W acquisition and utility adjustment or only one of these two tasks. Drivers #5 (Status of Schematic Design), #6 (Status of Boundary Surveying), #7 (Status of Environmental Clearances), and #8 (Status of Right-of-Way Map) are relevant to the status of the preliminary design phase that should be completed prior to the initiation of property appraisal. Three values, such as “Completed,” “In-Progress,” and “Not Started,” are offered to present the status of all of these preliminary design-related drivers.

Drivers #9 (Internal R/W Staff Size of a District) and #10 (District R/W Annual Budget) are the identified drivers from Project 0-4617. That is, these drivers are among the key factors that were statistically analyzed and included in the RUDI tool. The size of districts’ staff and district’s R/W annual budget was considered important in delivering R/W acquisition and utility adjustment because the delivery time of TxDOT’s historical projects varied widely due to the size of these two drivers,

Drivers pertinent to the type of project funding and any limitations in funding include #11 (Dedications of Funds to the Project: R/W and Construction), #12 (LPA Funded or Non-LPA Funded), #13 (Federally Funded or Non-Federally Funded), and #14 (Funding Limitations for the Project). Through identifying a project’s funding characteristics, it is possible for practitioners to become more able to consider the probable impact of each of the drivers’ values on the project schedule.

Drivers #15 and #16 describe levels of public approval of the project and levels of political pressure. As summarized in the literature review section, these factors have been considered to be important in scheduling highway projects. The last driver (#18) in the project basic facts-related category gives information on the current status of the R/W project that is being characterized by the practitioners.

Project Basic Facts	
Driver	**Value**
1. ☐ TxDOT Project Type	☐ RER (Rehabilitation of Existing Road) ☐ UGN (Upgrade to Standards Non-Freeway) ☐ NNF (New Location Non-Freeway) ☐ INC (Interchange - New or Reconstructed) ☐ WF (Widen Freeway) ☐ WNF (Widen Non-Freeway) ☐ BR (Bridge Replacement) ☐ CNF (Convert Non-Freeway to Freeway) ☐ HES (Hazard Elimination/Safety) ☐ MSC (Miscellaneous) ☐ NLF (New Location Freeway) ☐ OV (Overlay) ☐ UPG (Upgrade to Standards ☐ BWR (Bridge Widening/Repair)
2. ☐ TxDOT Highway Type	☐ IH (Interstate) ☐ SH (State Highway) ☐ FM (Farm to Market road) ☐ CS (City Street) ☐ US (US highway) ☐ RM (Ranch to Market road)
3. ☐ Project Location Type	☐ Urban ☐ Rural ☐ Metropolitan
4. ☐ Right-of-Way and Utility Scope	☐ Only R/W acquisition ☐ Only Utility adjustment ☐ Both R/W acquisition and Utility adjustment
5. ☐ Status of Schematic Design	☐ Completed ☐ In-progress ☐ Not Started
6. ☐ Status of Boundary Surveying	☐ Completed ☐ In-progress ☐ Not Started
7. ☐ Status of Environmental Clearance	☐ Completed ☐ In-progress ☐ Not Started
8. ☐ Status of Right-of-Way Map	☐ Completed ☐ In-progress ☐ Not Started

Figure 5.1: Model Project Description Form – Project Basic Facts-related Part

9. ☐ Internal R/W Staff Size of a District	☐ Less than 9 FTEs ☐ 9 or more than 9 FTEs
10. ☐ District R/W Annual Budget	☐ Less than $6million ☐ More than $6million
11. ☐ Dedication of Funds to the Project (R/W and Construction)	☐ Yes ☐ No ☐ Unknown
12. ☐ LPA Funded or Non-LPA Funded	☐ LPA funded ☐ Non-LPA funded
13. ☐ Federally Funded or Non-Federally Funded	☐ Federally funded ☐ Non-Federally funded
14. ☐ Funding Limitations for the Project	☐ LPA or Utility Company needing an SIB loan ☐ Partial payments from funding ☐ Time required to fund the project ☐ Other ____________ ☐ None
15. ☐ Level of Acceptance of the Project by the Public	☐ Extensive supportive ☐ Not supportive ☐ Mixed
16. ☐ Level of Political Pressure	☐ Extensive ☐ Moderate ☐ Minimal
17. ☐ Common Concerns of Property Owners	☐ Access ☐ Safety ☐ Project duration ☐ Compensation ☐ Other ____________
18. ☐ Current Status of the R/W Project	☐ Request R/W CSJ ☐ Request R/W full release ☐ Assigned R/W CSJ ☐ R/W full release ☐ Pending release

Figure 5.1: Model Project Description Form – Project Basic Facts-related Part (continued)

5.2.1.2 Right-of-Way Acquisition-related Drivers

As described in Figure 5.2, there are 15 drivers that affect the durations of the R/W acquisition process. Different from the project basic facts-related drivers, these 15 drivers were identified as factors that affect only the delivery time of R/W acquisition, although R/W acquisition interacts with utility adjustment in a highway project.

Driver #19 (Number of Parcels for Acquisition) is one of the key drivers included in the RUDI tool. Three proposed ranges are provided to assess the number of parcels that need to be acquired for the project. The process of identifying various types of parcel usages and frequency of claims of eminent domain is described in Drivers #20 (Different Types of Parcel Usages) and #21 (Frequency of Eminent Domain), respectively.

Drivers #22 (Source of Personnel to be used for R/W Acquisition), #23 (Availability of District R/W Appraisers: District Staff and Outsourced), and #24 (Is Funding Available for Outsourcing Staff Assistance?) relate to the resources needed for acquiring the properties. Specifically, Driver #22 identifies the type of personnel resources for R/W acquisition. Currently, most districts in TxDOT utilize both outsourced staff and their own professional staff, so driver #22 tracks these differences. Driver #23 describes the level of availability of R/W appraisers that can be outsourced or employed by the district. Funding availability for outsourcing assistance is presented in Driver #24.

For R/W acquisition, information regarding property owners is very useful. Driver #25 (Type of Property Owners) identifies the types of property owners as either all in-state or some out-of-state. Related to this driver, Driver #26 (Level of Familiarity with Key Landowners) asks about the level of knowledge about property owners. In addition, any concerns of property tenants are considered in Driver #27 (Aare There Any Property Tenants to Considers?).

Drivers #28 (Need for Residential Relocation), #29 (Level of Local Availability of Replacement Housing Facilities), #30 (Need for Business Relocation), and #31 (Level of Local Availability of Replacement Business Facilities) ask about any needs for residential or business relocation and resource availability for meeting these needs in the R/W acquisition process.

The final drivers in this set, drivers #32 (Likelihood of Title Curative Actions) and #33 (Responsiveness of Local Title Companies to TxDOT), identify the likelihood of title curative actions during the R/W acquisition process and the level of responsiveness of local title companies to TxDOT.

Right of Way Acquisition			
Driver	**Value**		
19. ☐ Number of Parcels for Acquisition	☐ Less than 10	☐ 10 to 30	☐ More than 30
20. ☐ Different Types of Parcel Usages	☐ Vacant ☐ Agricultural ☐ Other ______	☐ Residential ☐ Religious facility	☐ Commercial ☐ Parking lot ☐ Unknown
21. ☐ Frequency of Eminent Domain	☐ Several ☐ Unknown	☐ Some	☐ None
22. ☐ Source of Personnel to be used for R/W Acquisition	☐ Outsourced	☐ District staff	☐ Unknown
23. ☐ Availability of District R/W Appraisers (District Staff and Outsourced)	☐ Adequate	☐ Marginally adequate	☐ Inadequate
24. ☐ Is Funding Available for Outsourcing Staff Assistance?	☐ Yes	☐ No	☐ Unknown
25. ☐ Type of Property Owners	☐ All in-state	☐ Some out-of-state	☐ Unknown
26. ☐ Level of Familiarity with Key Landowners	☐ High	☐ Low	☐ Unknown
27. ☐ Are There Any Property Tenants to Consider?	☐ Yes	☐ No	☐ Unknown
28. ☐ Need for Residential Relocation	☐ Substantial	☐ Some	☐ None
29. ☐ Level of Local Availability of Replacement Housing Facilities	☐ High ☐ Unknown	☐ Medium	☐ Low
30. ☐ Need for Business Relocation	☐ Substantial	☐ Some	☐ None

Figure 5.2: Model Project Description Form – Right-of-Way Acquisition-related Part

31. ☐ Level of Local Availability of Replacement Business Facilities	☐ High ☐ Medium ☐ Low ☐ Unknown
32. ☐ Likelihood of Title Curative Actions	☐ High ☐ Medium ☐ Low ☐ Unknown
33. ☐ Responsiveness of Local Title Companies to TxDOT	☐ High ☐ Medium ☐ Low ☐ Unknown

Figure 5.2: Model Project Description Form – Right-of-Way Acquisition-related Part (continued)

5.2.1.3 Utility Adjustment-related Drivers

This section introduces the nine duration drivers that affect the durations of utility adjustment as described in Figure 5.3. Similar to the R/W acquisition duration drivers, the identified drivers are considered to be factors that affect only the duration of utility adjustment, not R/W.

Surface Utility Engineering (SUE) is one of the best strategies used by many state DOTs for effectively adjusting or relocating utilities (Ellis 2005). Drivers #34 (Have SUE Investigations been Performed?) and #35 (Will SUE Investigations be Performed?) ask whether the SUE performed for the utility adjustment process. Driver #36 describes the types of utilities that are commonly identified by TxDOT.

Drivers #37 (Number of Utilities Located in Public R/W) and #38 (Number of Utilities Located in Private Easement) determine the number of utilities depending on location types, such as public right-of-way and private easement. The number of utilities that need to be adjusted or relocated is described by Driver #39 (Number of Utilities for Adjustments or Relocations).

Including utility adjustment in the construction contract is also one of the common strategies used by many state DOTs. Driver #40 asks if this approach is utilized or not. Driver #41 (Responsiveness of Utility Companies to TxDOT Needs) relates to the level of responsiveness of utility companies to TxDOT needs, and Driver #42 (Adjustment is Reimbursable or Non-Reimbursable Utility) asks whether the project's utility adjustment is reimbursable or not.

Utility Adjustment	
Driver	**Value**
34. ☐ Have SUE Investigations Been Performed?	☐ Yes ☐ No ☐ Unknown
35. ☐ Will SUE Investigations Be Performed? (If no or unknown in the driver # 34)	☐ Yes ☐ No ☐ Unknown
36. ☐ Utility Type	☐ Overhead power ☐ Buried power ☐ Waste water ☐ Water ☐ Underground communication ☐ Overhead communication ☐ Gas ☐ Other ____________ ☐ Unknown
37. ☐ Number of Utilities Located in Public R/W	☐ Less than 4 ☐ 4 to 7 ☐ More than 7 ☐ Unknown
38. ☐ Number of Utilities Located in Private Easement	☐ Less than 4 ☐ 4 to 7 ☐ More than 7 ☐ Unknown
39. ☐ Number of Utilities for Adjustments or Relocations	☐ Less than 4 ☐ 4 to 7 ☐ More than 7 ☐ Unknown
40. ☐ Is there any Utility Adjustment to be Included in the Highway Construction Contract?	☐ Yes ☐ No ☐ Unknown
41. ☐ Responsiveness of Utility Companies to TxDOT Needs	☐ High ☐ Medium ☐ Low ☐ Unknown
42. ☐ Adjustment is Reimbursable Utility or Non-Reimbursable Utility	☐ Reimbursable ☐ Non-reimbursable ☐ Unknown

Figure 5.3: Model Project Description Form – Utility Adjustment-related Part

5.2.2 Usage Guideline

As previously mentioned, the 42 duration drivers were based on opinions of the experts who are currently responsible for acquiring properties and adjusting or relocating utilities in their local districts. Because these drivers were derived from such expert opinion, they can be useful in representing the major characteristics of a highway project. So, other practitioners can use this form consisting of the 42 duration drivers and their relevant values to better understand their own highway projects. Furthermore, characterizing highway projects through the use of this form can assist experts in forecasting the durations of R/W acquisition and utility adjustment by providing practitioners with additional drivers that should be considered, those about which they might not have otherwise known. In other words, practitioners can obtain more information on their projects to help predict durations of R/W acquisition and utility adjustment. The following steps are recommended to apply this form more accurately:

- Find information on the identified 42 duration drivers through examining related documents and interviewing practitioners who have the best knowledge about the driver.
- Fill out the form using the identified values.
- Evaluate the importance of the 42 drivers characterizing the project and determine a list of drivers that should be recognized as the key drivers in forecasting the duration of the project's R/W acquisition and utility adjustment processes.
- Get the possible duration ranges recommended by the RUDI tool and determine the final durations considering the additional critical drivers that were identified in the assessments of relative levels of importance.

5.3 SELECTION OF TXDOT HIGHWAY PROJECTS FOR STUDY

5.3.1 Major Characteristics

For the data collection, three recently completed TxDOT highway projects were selected from the Right-of-Way Information System (ROWIS). Three projects were chosen based on estimated construction letting dates as well as differences among them in major characteristics such as project location, highway type, numbers of parcels, and so on. The major characteristics of the selected projects are described in more detail in Table 5.2. All characteristics of these three projects were described in the MPDFs specific to each project. These three forms are also described in Appendix C.

Table 5.2: Major Characteristics of the Selected TxDOT Highway Projects

Model Project	Major Characteristics				
	Project Location	Highway Type	Project Scope	# of Parcels	Utility Type
A	Metropolitan	Interstate Highway	R/W & Utility	10 to 30	Water and Gas
B	Rural	Farm to Market Road	R/W & Utility	More than 30	Waste water, & Gas
C	Rural	US Highway	R/W & Utility	More than 30	Oil and Pipelines

5.3.2 Actual Durations of Completion

These three highway projects, which were selected based on their unique characteristics and their scheduled letting dates, were used at the beginning of this implementation research study. However, as described in Table 5.3, two of them have not been completed. The main reason for this incompletion has been the lack of funding on the part of TxDOT. Only project B has been successfully delivered on schedule.

Due to the incompletion of projects A and C, this study utilized only project B in the collection of the main data set for study findings. Projects A and C were used to validate part of the findings based on the analysis of the data provided by project B.

As mentioned in Chapter 3, there are five milestones constituting six key durations of R/W acquisition and utility adjustment. M1 presents the R/W project release date while M2 and M3 present the initial appraisal date and possession of parcel date, respectively. These three milestones constitute three durations (R1, R2, and R3) of R/W acquisition. Moreover, for utility adjustment, M1, M4, and M5 are the designated milestones. M4 and M5 represent the final project utility adjustment agreement execution date and the final project utility adjustment completion date, respectively. Similar to the R1, R2, and R3 durations, three durations (U1, U2, and U3) of utility adjustment consist of M1, M4, and M5.

Table 5.3: Actual Completion Dates of the Selected Model Projects

Model Project	Key Milestone					Construction Letting Date
	M1	M2	M3	M4	M5	
A	11/22/2004	2/20/2005	11/12/2007	N/A	N/A	N/A
B	10/14/2004	11/17/2004	12/19/2006	11/19/2007	01/30/2008	01/31/2008
C	11/07/2003	12/12/2003	06/23/2005	N/A	N/A	N/A

Figure 5.4 presents the real-time, detailed durations of the six designated durations in R/W acquisition and utility adjustment for Project B. For R/W acquisition, the R1 and R2 took 34 days and 762 days respectively. The sum of these durations is R3, which is 796 days. For utility adjustment, the U1 and U2 took 1131 days and 72

days, respectively. U3, which is from "R/W Project Release" to "Final Project Utility Adjustment Completion," took 1203 days.

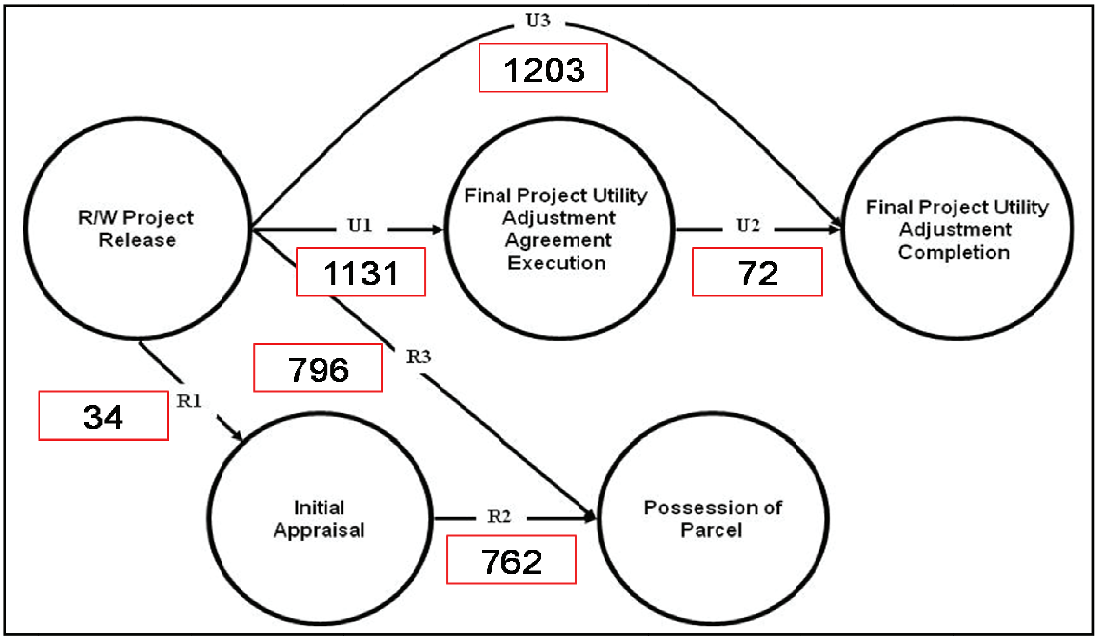


Figure 5.4: Actual Completion Durations of Model Project B

5.4 RUDI TRAINING

5.4.1 RUDI Application Procedure

In this study, RUDI training sessions were provided after study participants had estimated the durations of Project B manually, and after they had assessed the importance of the drivers without having been given their project-specific values. Through a one-hour training session, the users were taught how to use the RUDI tool. The brief procedure followed is detailed below:

- First, the user should print the Project Duration Record Form (Appendix E) that allows the user to record information as they use RUDI. The Project Duration Record Form then becomes part of the project's documentation.

- Second, the user needs to characterize the project's parameters for the duration estimation. More specifically, characterizing the project for R/W acquisition means that the user needs to identify the following items: the number of parcels, location type, district R/W staff size, and district annual R/W budget for R/W acquisition. For utility adjustment, the following items about the project need to be identified: TxDOT highway type, TxDOT project type, utility type, reimbursable or non-reimbursable status, LPA funded or non-LPA funded status, federally funded or non-federally funded status, location type, and adjustment speed.
- Third, the user also needs to judge both the project's degree of schedule urgency and degree of uncertainty. These judgments should mostly be based on the user's experience with and evaluation of previous TxDOT projects' performance. These degrees should be expressed as percentile ranges.
- Fourth, after the selection of the percentile ranges as described in step three, the user needs to find more detailed information for each of the three durations of R/W acquisition (R1, R2, and R3) and utility adjustment (U1, U2, and U3), respectively. The user has access to the duration data, and these are presented in two different formats: statistical plots and statistical information. Each presentation is a plot describing cumulative percentile versus time (calendar days) for a certain duration. The user needs to record durations for each of the drivers described above.
- As a final procedure, the user should select the most reasonable duration within the range obtained from completing the duration record forms. This selection depends considerably on the user's personal judgment based on his or her knowledge of previous projects.

5.4.2 Assessing Uncertainty and Schedule Urgency

Users can select one percentile range for R/W acquisition and utility adjustment or choose two different percentile ranges for each process. Users should rely on their own personal judgment when they select these ranges. Because personal judgment plays a critical role in percentile selection, differences among experts can cause variability in the estimated durations of the recommended percentile ranges.

In order to select reasonable percentile ranges from the percentile range guidance matrix described in Table 3.2 in Chapter 3, users need to assess the degree of schedule urgency and uncertainty of a project. Users should take a close look at the drivers that affecting schedule urgency and uncertainty to determine these degrees. The drivers suggested by the research team are as follows, divided into two lists based on their relevance to uncertainty and urgency. The first lists the drivers affecting uncertainty, while the second includes those affecting schedule urgency.

- Uncertainty drivers:
    - Project funding limitations (relative to cost)
    - Project scope
    - Familiarity with local landowners
    - Knowledge of existing utility facilities
    - Level of cooperation between DOT and local utilities
    - Property title-related uncertainties
- Schedule Urgency drivers:
    - Level of political pressure
    - Relative highway user costs involving traffic delays
    - Level of district R/W support resources available
    - Contract letting pressure

Revising the percentile range guidance matrix and adding more drivers that should be considered in assessing schedule urgency and uncertainty were critical to improve the accuracy of the RUDI tool for predicting durations for R/W acquisition and utility adjustment on highway projects. Study efforts to achieve these objectives are described in Chapter 8 in more detail.

Chapter 6: Data Collection

6.1 DATA COLLECTION PROCEDURE

For the study, all of the data collection activities were conducted in interactive workshops. The data collected for this study were divided into three parts: (1) backgrounds of study respondents; (2) importance of duration drivers, and; (3) duration estimation.

First, respondents were asked to answer questions regarding their background, which included items such as their areas of expertise, years of experience, and types of district location. Second, the PRE-application importance of the duration drivers was evaluated. No information on the duration drivers was given to the study participants to help them assess this importance so that their pre-existing beliefs could be determined. Third, after the assessment of the PRE-application importance, respondents were asked to predict the durations of the R/W acquisition and utility adjustment processes of model project B using their judgments. Fourth, the estimation based on the RUDI tool was conducted. For this duration estimation, unlike the previous two, the research team provided training sessions to the respondents in advance. Fifth, after the RUDI-based estimations had been completed, the POST-application importance assessment of the drivers was evaluated.

6.2 DEVELOPMENT OF DATA COLLECTION TOOLS

In order to collect respondents' assessments of the importance of the identified 42 duration drivers, the evaluation questionnaires, called RUDI questionnaires, were developed. The following section describes a partial section of the questionnaires for assessing the importance of duration drivers and for collecting study participants' backgrounds that were used as independent variables in analyzing its relationships with the importance of drivers and the accuracy of duration estimation based on RUDI and personal judgments. The full version of the questionnaires is illustrated in Appendix D.

6.2.1 RUDI Questionnaires

6.2.1.1 Section about Study Participants' Background

Figure 6.1 presents several questions regarding the respondents' background such as their current district location, current position title, and number of years of experience in R/W and/or utility adjustment work, etc.

A. Personal information

Name:____________________________

Email address:______________________ Phone number:______________________

B. Current district

☐Abilene	☐Amarillo	☐Austin	☐Beaumont
☐Childress	☐San Angelo	☐Lufkin	☐El Paso
☐Laredo	☐Odessa	☐Bryan	☐Wichita Falls
☐Other ______________			

C. Current position title

☐R/W administrator	☐R/W appraiser	☐R/W agent
☐Utility agent	☐Other ______________	

D. Number of years of industry experience in R/W or (and) Utility adjustment work

____

Figure 6.1: Partial Section of the RUDI Questionnaires

6.2.1.2 Section about Duration Drivers' Importance Assessment

This part of the questionnaire was intended to assess the level of importance participants granted the drivers before they forecasted durations for acquiring right-of-way and adjusting utilities. In this study, this importance is called the "PRE-Application Importance" of duration drivers. In this assessment, study participants were asked to rate the level of importance of each driver without having been given specific information (values). As described in Figure 6.2, the scale's points were labeled "not important," "low," "moderate," and "high."

Driver	Level of Importance in Determining Durations			
Project Basic Facts	Not Important	Low	Moderate	High
1. TxDOT Project Type	☐	☐	☐	☐
2. TxDOT Highway Type	☐	☐	☐	☐
3. Project Location Type	☐	☐	☐	☐
4. Right-of-Way and Utility Scope	☐	☐	☐	☐
5. Status of Schematic Design	☐	☐	☐	☐

Figure 6.2: Partial Section of Drivers' PRE-Application Importance Assessment Form

Figure 6.3 describes a partial section of the questionnaire for assessing the "POST-Application Importance" of drivers. Respondents were asked to answer the following question: "Is this driver significant in determining your durations?" The post-application importance of duration drivers was evaluated on a simple 2-point scale, labeled "yes" or "no". This assessment was conducted after the duration estimations had already been completed. Therefore, for this assessment, the respondents were able to consider the real values of the identified 42 duration drivers.

Project Basic Facts		Significant Duration Driver?	
Driver	**Value**	**Yes**	**No**
1. TxDOT Project Type	☑ RER (Rehabilitation of Existing Road) ☐ UGN (Upgrade to Standards Non-Freeway) ☐ NNF (New Location Non-Freeway) ☐ INC (Interchange - New or Reconstructed) ☐ WF (Widen Freeway) ☐ WNF (Widen Non-Freeway) ☐ BR (Bridge Replacement) ☐ CNF (Convert Non-Freeway to Freeway) ☐ HES (Hazard Elimination/Safety) ☐ MSC (Miscellaneous) ☐ NLF (New Location Freeway) ☐ OV (Overlay) ☐ UPG (Upgrade to Standards ☐ BWR (Bridge Widening/Repair)	☐	☐
2. TxDOT Highway Type	☐ IH (Interstate) ☐ SH (State Highway) ☑ FM (Farm to Market road) ☐ CS (City Street) ☐ US (US highway) ☐ RM (Ranch to Market road)	☐	☐
3. Project Location Type	☐ Urban ☑ Rural ☐ Metropolitan	☐	☐

Figure 6.3: Partial Section of Drivers' POST-Application Importance Assessment Form

6.3 TYPES OF DATA

As previously mentioned, the data needed for this study included three categories: (1) experts' backgrounds, (2) driver importance, and (3) duration estimation. Each group includes its own sub-groups. The data regarding respondents' backgrounds include years of experience, areas of expertise, and types of district. Driver importance is divided into PRE-application and POST-application importance, while non-RUDI-based duration and RUDI-based duration are the types of duration data. Details about each data group are offered in the following sections.

6.3.1 Background of Study Participants

For this study, the research team conducted seven workshops that included RUDI training sessions to participants from 17 districts in Texas. These districts included

Abilene, Amarillo, Austin, Beaumont, Brownwood, Bryan, Childress, El Paso, Dallas, Fort Worth, Houston, Laredo, Lubbock, Lufkin, Paris, San Angelo, and Wichita Falls. As presented in Table 6.1, the total number of workshop attendees was 73. Forty-three out of the 73 experts provided data for analyzing the importance of the duration drivers and the duration estimation for Project B. Twenty-five out of these 43 experts were working on R/W acquisition-related fields, and the remaining 18 were responsible for utility adjustments in their districts. Fifteen experts from urban or metropolitan districts (such as Austin, El Paso, Fort Worth, and Dallas) participated. In addition, 28 experts were from rural ones, such as Lubbock, Abilene, Paris, Childress, and so forth.

Table 6.1: Characteristics of Study Participants: Types of District and Areas of Expertise

Workshop	Workshop Attendees (n)	Study Participants (n)	Areas of Expertise		District Types of Study Participants		
			R/W	Utility	Rural	Urban	Metropolitan
#1	7	6	5	1	6	0	0
#2	3	2	1	1	2	0	0
#3	9	8	5	3	3	5	0
#4	10	2	0	2	0	2	0
#5	8	5	3	2	0	0	5
#6	20	11	6	5	9	2	0
#7	16	9	5	4	8	1	0
Total	**73**	**43**	**25**	**18**	**28**	**10**	**5**

Practitioners' experience, expressed in terms of years, was selected as one of the independent variables for the data analysis. Therefore, it was necessary to catalog the participants' experience. Table 6.2 offers a description of the practitioners' years of experience based on their areas of expertise. As Table 6.2 describes, the average years of experience were 16 and 11 for practitioners in R/W acquisition and utility adjustment, respectively. Among the 43 practitioners, there were eight R/W ones with less than 13 years of experience and 17 R/W ones with more than 13. Moreover, 13 out of 18 utility practitioners had less than 13 years of experience, while five practitioners had more than 13 years of experience.

Table 6.2: Characteristics of Study Participants: Years of Experience

Workshop	Study Participants (n)	Area of Expertise		Mean (years)		R/W Practitioners		Utility Practitioners	
		R/W	Utility	R/W	Utility	<13 (years)	>13 (years)	<13 (years)	>13 (years)
#1	6	5	1	19.5	6.5	1	4	1	0
#2	2	1	1	15.0	13.0	0	1	0	1
#3	8	5	3	15.6	10.0	1	4	3	0
#4	2	0	2	0	2.0	0	0	1	1
#5	5	3	2	13.3	13.6	1	2	2	0
#6	11	6	5	16.5	12.5	4	2	4	1
#7	9	5	4	15.6	18.5	1	4	2	2
Total	**43**	**25**	**18**	**16**	**11**	**8**	**17**	**13**	**5**

Figure 6.4 is a scatter plot of the practitioners' years of experience. As presented in Figure 6.4, more than half of the study's participants had over 10 years of experience, though there were practitioners with less than five years of experience. For further analysis, the study participants were grouped into two groups using their years of experience. A threshold of 13 years of experience was used for categorization purposes. This cut-off point was the best value allowing two groups have an equivalent sample size.

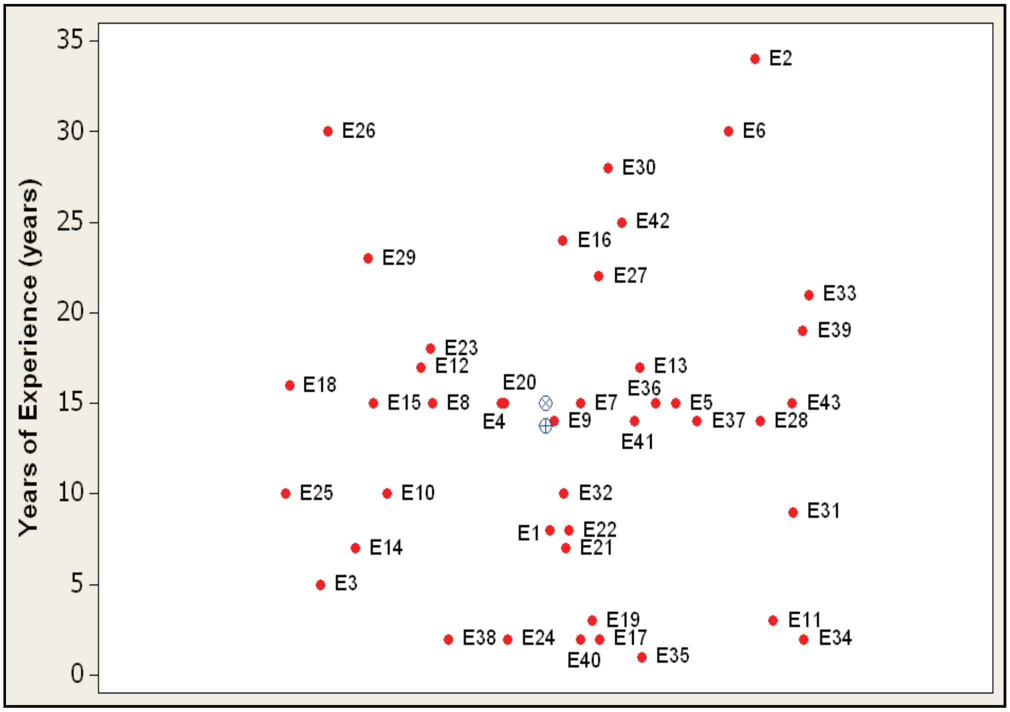


Figure 6.4 Scatter Plot of Study Participants' Years of Experience

6.3.2 PRE-Application Importance of Duration Drivers

One of the approaches to assess the identified duration drivers that affect duration of R/W acquisition and utility adjustment was to evaluate the relative importance of duration drivers without providing the participants with any information regarding the drivers. This methodology was chosen to allow an investigation into what drivers might differentiate accurate estimators from inaccurate ones.

6.3.3 POST-Application Importance of Duration Drivers

After duration estimation was completed, respondents were asked to evaluate the importance of duration drivers, this time with their specific values included. Through this assessment, it was possible to see if practitioners changed their perceptions as compared to the PRE-importance of duration drivers.

6.3.4 Non-RUDI-based Duration Estimation

Three durations (R1, R2, and R3) for R/W acquisition and three durations (U1, U2, and U3) for utility adjustment were predicted using two different methods. The first method was to have participants utilize their personal judgment for predicting duration, which are called non-RUDI-based duration estimation in this study. Without receiving any assistance from the tool, respondents predicted the durations of model projects. These estimated durations were used for a comparative analysis with the RUDI-based duration estimation, which is described in the following section.

6.3.5 RUDI-based Duration Estimation

As previously mentioned, the RUDI tool was used as one of the data collection tools in this study. Using the RUDI tool, the same six durations of R/W acquisition and utility adjustment were estimated. As mentioned in Chapter 3, the RUDI tool provides statistical information on TxDOT's historical highway projects.

Chapter 7: Findings on Determining Durations for R/W Acquisition and Utility Adjustment

7.1 Overview

This chapter consists of six sections and describes the results of various analyses conducted in this study. These analyses were intended to identify key findings related to the enhancement of the RUDI tool. Following this overview section, Section 7.2 presents the variability of the durations estimated by the study participants using two different estimation strategies, non-RUDI-based estimations and RUDI-based estimations. Moreover, the methodology for determining the accuracy of duration estimation, which was used in the subsequent statistical analyses, is described in this section. Section 7.3 describes how project B fits with the RUDI tool and compares the accuracy of RUDI-based duration estimations with the accuracy of non-RUDI-based duration ones to determine if the RUDI-based approach is useful in predicting durations. Section 7.4 illustrates the analysis results of the PRE and POST-application driver importance assessments on the basis of personal judgments separated by their backgrounds. Building on Section 7.4, Section 7.5 summarizes the results of the analysis of associations between duration estimation accuracy and practitioners' backgrounds using a chi-square test. In addition, the PRE and POST-application driver importance assessments of more and less accurate estimators were analyzed in this section. Finally, Section 7.6 illustrates the analysis of the impact of drivers' values on the importance level of those drivers by comparing PRE-application importance and POST-application importance ratings of the drivers. Lastly, Section 7.7 offers influential drivers that can be used as additional key drivers in improving the RUDI tool.

The influential drivers were solely based on the analysis results of the PRE-application driver importance assessments.

7.2 ACCURACY OF DURATION ESTIMATION

One of the most effective statistical approaches to investigate the ranges, portions, or outliers, if any, in the data is the Box-Whisker plot (or diagram) known as a boxplot. Boxplots are useful in graphically displaying the degree of dispersion of the data and the level that it may be skewed in the data without making any statistical assumptions.

As illustrated in Figure 7.1, the central portion indicates that the middle 50 percent of the data ranges from the end of the first quartile (25^{th} percentile) to the end of the third quartile (75^{th} percentile). This portion is also called the interquartile range (IQR). The mean and the median are included in the box. The end points of the boxplot indicate the last data observation that is included in the 1.5 IQR. Data outside the 1.5 IQR can be considered to be outliers, and these are displayed using asterisks or other characters.

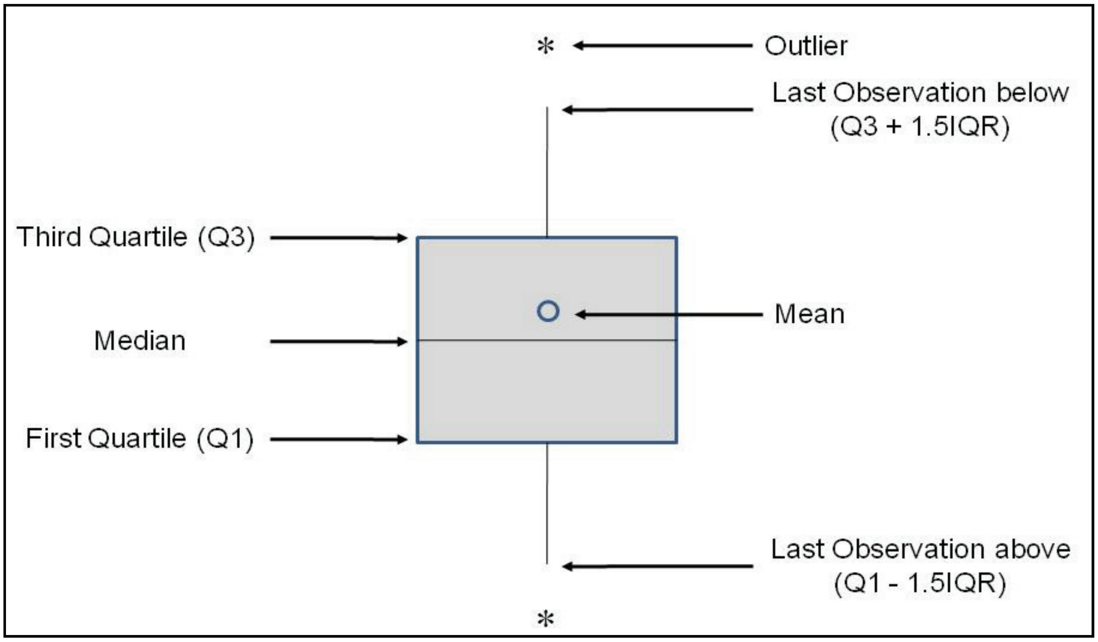


Figure 7.1: Sample Box-Whisker Plot

7.2.1 Variability of Estimated Durations

As mentioned in the data collection chapter, respondents were asked to estimate the durations of project B using both their personal judgments and the RUDI tool. The estimated durations based solely on personal judgments were called non-RUDI-based durations. In contrast, those made using the RUDI tool were named RUDI-based durations. This section describes the statistical variability among the estimated durations using RUDI and personal judgments.

7.2.1.1 Non-RUDI-based Duration Estimations

43 practitioners who were currently responsible for R/W acquisition or utility adjustment-related tasks estimated the six durations described below for project B. As described in Chapter 6, there are three durations each for R/W acquisition and utility

adjustment. The letters "R" and "U" represent "Right-of-Way" and "Utility," respectively. In addition, the letter "N" represents "Non-RUDI-based."

As described in Table 7.1, the durations NR1 and NU2, which are the shortest durations for R/W acquisition and utility adjustment, were overestimated by experts who tended to think these processes would take longer than they did. In contrast, the means of the remaining two durations for each process (NR2 and NR3 for R/W acquisition and NU1 and NU3 for utility adjustment), respectively, revealed large differences from the actual durations, although some of the estimated numbers cover or meet the actual durations. In other words, with the exception of NR1 and NU2, the remaining durations were significantly underestimated.

Table 7.1: Variability of Non-RUDI-based Durations of Project B

		R/W Acquisition Duration			**Utility Adjustment Duration**		
Key Milestone		**NR1**	**NR2**	**NR3**	**NU1**	**NU2**	**NU3**
Actual Duration		34	762	796	1131	72	1203
Sample Size		43	43	43	43	43	43
Mean		167.35	417.26	578.60	490.35	289.81	709.19
Median		180.00	365.00	540.00	365.00	240.00	730.00
Standard Deviation		101.770	232.604	277.311	332.572	185.499	314.531
Variance		10357.233	54104.528	76901.578	110604.042	34410.060	98929.679
Range		450	852	1140	990	870	1080
Minimum		30	60	120	90	30	180
Maximum		480	912	1260	1080	900	1260
Percentiles	25	90.00	200.00	320.00	180.00	180.00	365.00
	50	180.00	365.00	540.00	365.00	240.00	730.00
	75	180.00	540.00	800.00	850.00	360.00	1010.00

7.2.1.2 RUDI-based Duration Estimations

The variability of the estimated durations based on the RUDI tool is described in Table 7.2. The first letter "R" represents "RUDI-based." Although the variability in the predicted durations for project B is not significantly different compared to the non-RUDI-based durations, the means of RU1 (RUDI-based U1) and RU3 (RUDI-based U3) are more close to the actual durations, which suggest that RUDI improves estimations, than the means of NU1 (Non-RUDI-based U1) and NU3 (Non-RUDI-based U3) are. The range between the maximum and the minimum in the utility adjustment duration is larger than that of the non-RUDI-based durations, as presented in Table 7.2. However, there is also an underestimating pattern in the RUDI-based duration estimation. Specifically, the durations RR2 (RUDI-based R2) and RR3 (RUDI-based R3) for the R/W acquisition and the durations RU1 (RUDI-based U1) and RU3 (RUDI-based U3) for the utility adjustment were underestimated by the practitioners.

These two types of duration estimations based on the different strategies were compared to investigate how much they differed and which strategy worked more effectively to provide reasonable numbers to the users. A descriptive comparative analysis is presented in Section 7.3.

Table 7.2: Variability of RUDI-based Durations of Project B

		R/W Acquisition Duration			Utility Adjustment Duration		
Key Milestone		**RR1**	**RR2**	**RR3**	**RU1**	**RU2**	**RU3**
Actual Duration		34	762	796	1131	72	1203
Sample Size		43	43	43	43	43	43
Mean		249.91	316.33	610.35	766.56	171.70	875.02
Median		240.00	275.00	600.00	723.00	180.00	811.00
Standard Deviation		90.298	165.227	204.277	398.398	97.166	457.170
Variance		8153.705	27300.034	41729.233	158720.633	9441.311	209004.166
Range		400	674	950	2337	455	3169
Minimum		100	101	250	163	20	100
Maximum		500	775	1200	2500	475	3269
Percentiles	25	200.00	455.00	491.00	97.00	645.00	365.00
	50	275.00	600.00	723.00	180.00	811.00	730.00
	75	400.00	730.00	1000.00	214.00	1000.00	1010.00

7.2.2 Determination of Duration Estimation Accuracy

In order to achieve the objectives of this project, developing a methodology to determine the accuracy level of the estimated durations was required. Based on this methodology, durations predicted by 43 respondents were categorized for a comparative analysis to see whether the amount by which RUDI improved the accuracy of duration estimations depended upon experts' personal judgments.

7.2.2.1 Methodology for Determining Duration Estimation Accuracy

The following figure illustrates the categorization of estimators based on the accuracy of their estimates. As Figure 7.2 shows, quartile rankings in a boxplot were utilized as the fundamental differentiator. As mentioned in the section describing the Box-Whisker plot concept, boxplots in statistical analysis are useful in presenting the range and the quartile of the data as well as in identifying some outliers because they allow the reader to quickly process the given information. Because of this quality, boxplots using differences between actual durations and estimated durations for R/W acquisition and utility adjustment were produced for this study. Estimators with differences in the area including the first quartile range and lower 25th percentile of the IQR were defined as "More Accurate" estimators. Conversely, estimators with differences in the zone from the fourth quartile to the third quartile and higher 25th percentile of the IQR were considered to be "Less Accurate." Moderate accuracy was designated for the estimators with differences in the area including from the 37.5th percentile to the 62.5th percentile of the boxplot. Estimators included in this zone were called "Moderately Accurate Estimators."

This designation concept was utilized only for R2 and R3 as well as U1 and U3. R1 and U2 were not considered because these durations are usually the shortest ones in R/W acquisition and utility adjustment. Therefore, these durations' effects on the accuracy of duration estimation were disregarded. The following section describes the results of the accuracy analysis of the estimated durations based on both personal judgments and the RUDI tool.

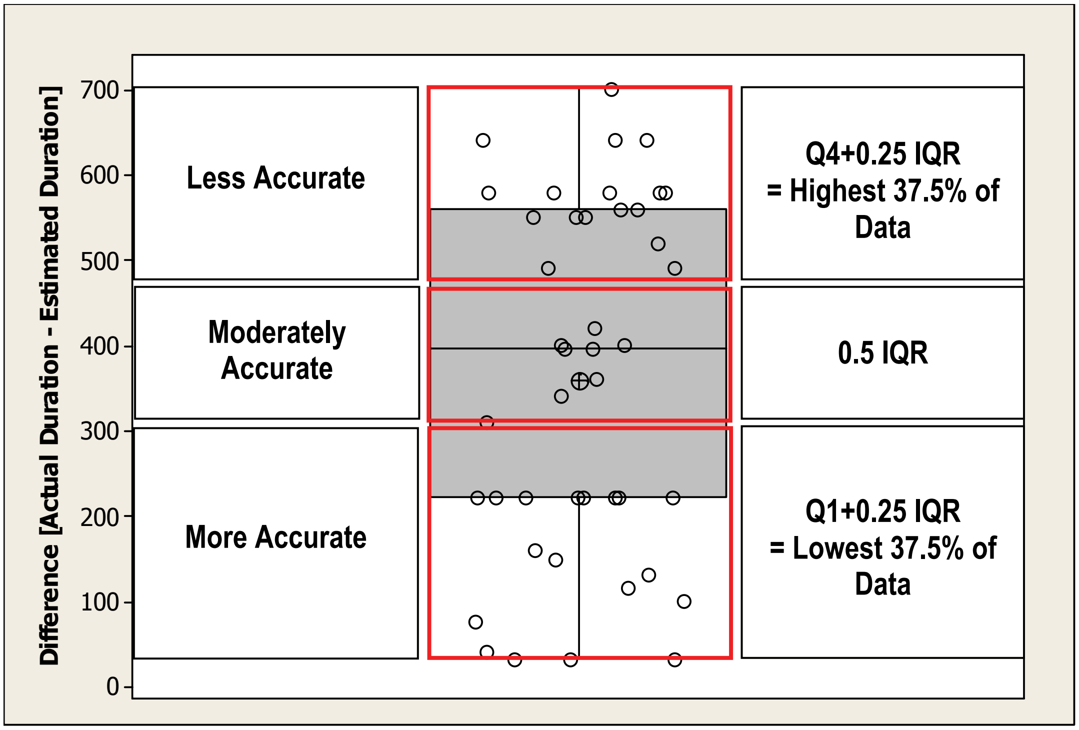


Figure 7.2: Methodology for Determining Duration Estimation Accuracy

7.2.2.2 Accuracy of Non-RUDI-based Duration Estimations

a. Duration of R/W Acquisition

The boxplot described in Figure 7.3 shows the differences between the R2 (from Initial Appraisal to Possession of Parcel) estimated durations and the actual durations. It appears to be reasonable to categorize 43 data points into three groups based on the scheme of accuracy determination described above. Data points under approximately 300 days were defined as More Accurate and some points over about 450 days were considered Less Accurate. The remaining points represent estimators with moderate accuracy. The accuracy of this non-RUDI-based duration is described in more detail in Table 7.3.

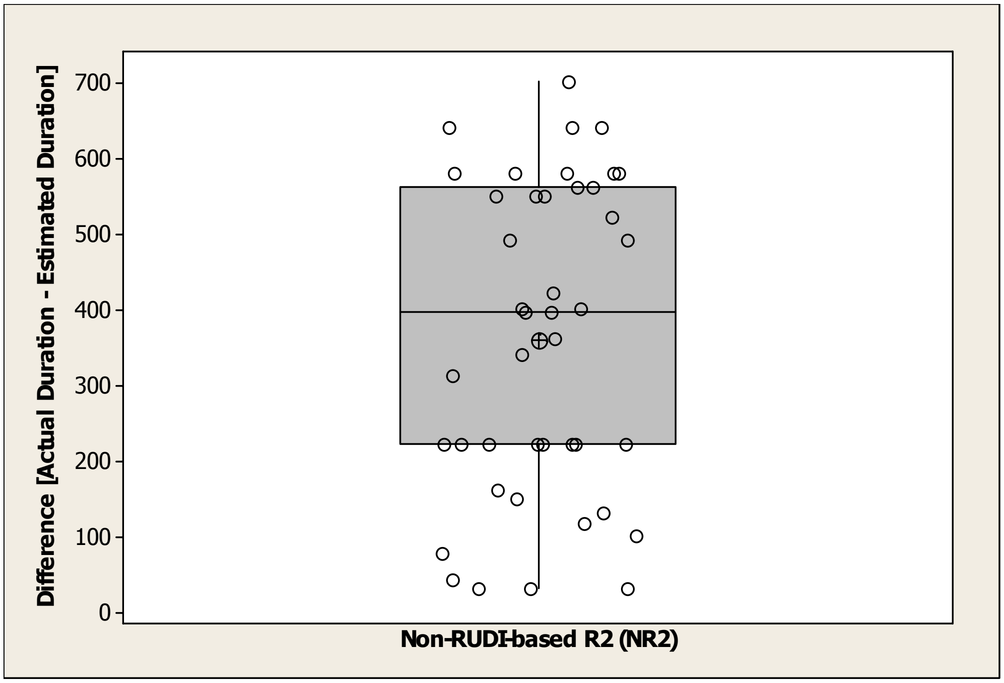


Figure 7.3: Boxplot of Non-RUDI-based R2 (NR2)

As described in Figure 7.4, the boxplot for R3 (from R/W Project Release to Possession of Parcel) is very similar to R2's. Data points under about 150 days were considered More Accurate and points over approximately 350 days were defined as Less Accurate. The remaining data fell within the middle zone of the interquartile range and were called Moderately Accurate estimators.

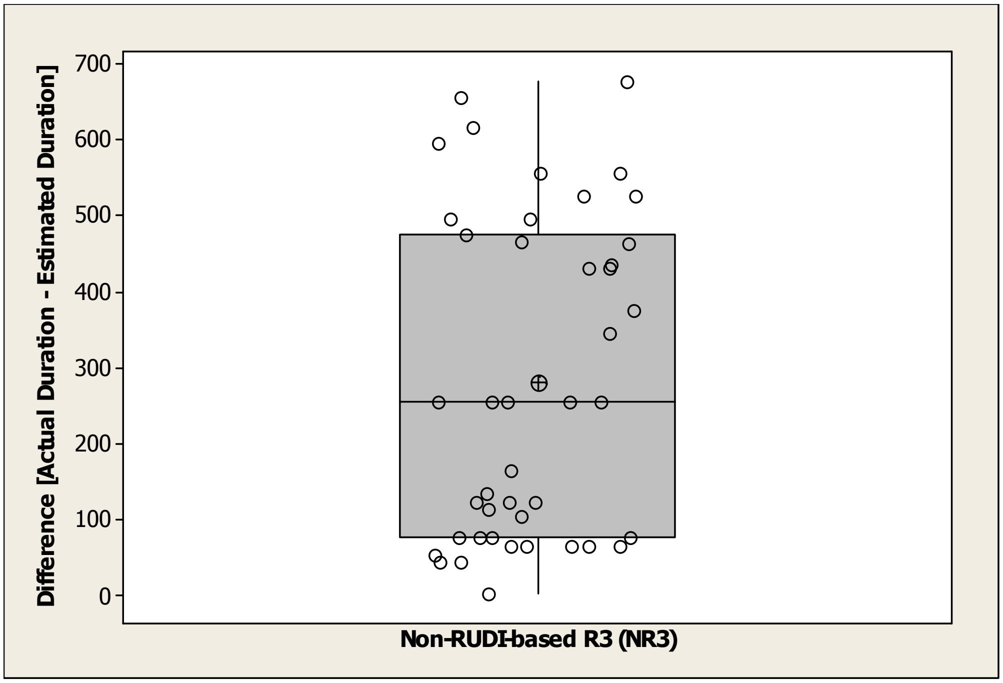


Figure 7.4: Boxplot of Non-RUDI-based R3 (NR3)

Table 7.3 describes the accuracy of the non-RUDI-based estimation of both R2 (from Initial Appraisal to Possession of Parcel) and R3 (from R/W Project Release to Possession of Parcel) durations in the R/W acquisition process. As this table illustrates, for R2, there were 18 More Accurate and 17 Less Accurate estimators. For R3, 19 More Accurate and 16 Less Accurate estimators were identified. However, only 14 estimators showed consistent accuracies in both R2 and R3 and these were called More Accurate estimators in predicting durations overall. In addition, there were 12 estimators who were considered Less Accurate in both R2 and R3. The remaining 15 estimators did not predict numbers with an equal level of accuracy in these two durations. Moderately Accurate estimators were discarded in this study because only perceptual differences between More Accurate and Less Accurate estimators in assessing the importance of drivers needed to be considered.

Table 7.3: Determination of Non-RUDI-based R/W Acquisition Duration Estimation Accuracy

Estr	R/W Acquisition		Accuracy of Estimation	Estr	R/W Acquisition		Accuracy of Estimation
	R2	R3			R2	R3	
E#1	Less	Less	Less Accurate	E#23	More	More	More Accurate
E#2	Moderately	Less	Moderately Accurate	E#24	Less	Less	Leas Accurate
E#3	More	More	More Accurate	E#25	Less	Moderately	Moderately Accurate
E#4	More	More	More Accurate	E#26	More	More	More Accurate
E#5	More	More	More Accurate	E#27	More	More	More Accurate
E#6	Less	More	Moderately Accurate	E#28	More	More	More Accurate
E#7	Moderately	Less	Moderately Accurate	E#29	Moderately	More	Moderately Accurate
E#8	More	More	More Accurate	E#30	Less	Less	Less Accurate
E#9	Less	Less	Less Accurate	E#31	Moderately	Less	Moderately Accurate
E#10	Less	Less	Less Accurate	E#32	Less	Less	Less Accurate
E#11	Less	Moderately	Moderately Accurate	E#33	Less	Less	Less Accurate
E#12	More	More	More Accurate	E#34	More	More	More Accurate
E#13	Less	Moderately	Moderately Accurate	E#35	Less	Less	Less Accurate
E#14	Moderately	Less	Moderately Accurate	E#36	More	Moderately	Moderately Accurate
E#15	Less	Less	Less Accurate	E#37	Less	Less	Less Accurate
E#16	Moderately	More	Moderately Accurate	E#38	Less	Less	Less Accurate
E#17	More	Moderately	Moderately Accurate	E#39	More	More	More Accurate
E#18	More	More	More Accurate	E#40	Less	More	Moderately Accurate
E#19	More	Moderately	Moderately Accurate	E#41	Less	Less	Less Accurate
E#20	More	More	More Accurate	E#42	Moderately	More	Moderately Accurate
E#21	More	Moderately	Moderately Accurate	E#43	Moderately	Moderately	Moderately Accurate
E#22	More	More	More Accurate				

b. Duration of Utility Adjustment

For non-RUDI-based duration estimation for utility adjustment, two boxplots were produced to present the dispersion of the differences of the estimated durations, as described in Figures 7.5 and 7.6, respectively. In contrast to the non-RUDI-based R/W acquisition durations, Figures 7.5 and 7.6 depict a wide range spanning the minimum and the maximum of differences. This pattern can be interpreted to mean that for estimators, predicting durations of utility adjustment appears to be more difficult and complex than it is for R/W acquisition. The results of the accuracy determination of utility durations are described in Table 7. 4.

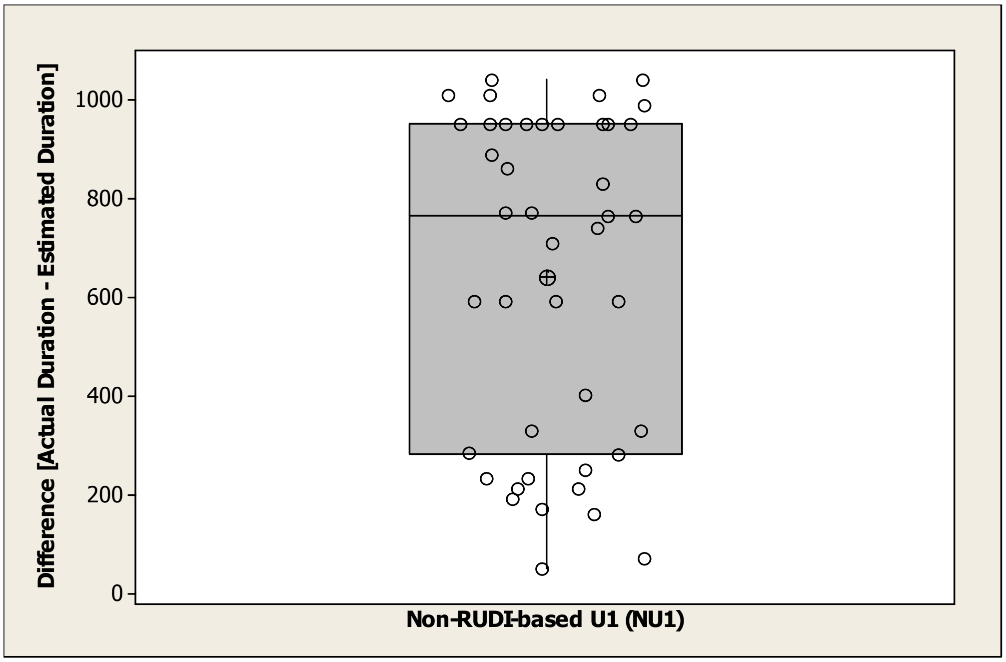


Figure 7.5: Boxplot of Non-RUDI-based U1 (NU1)

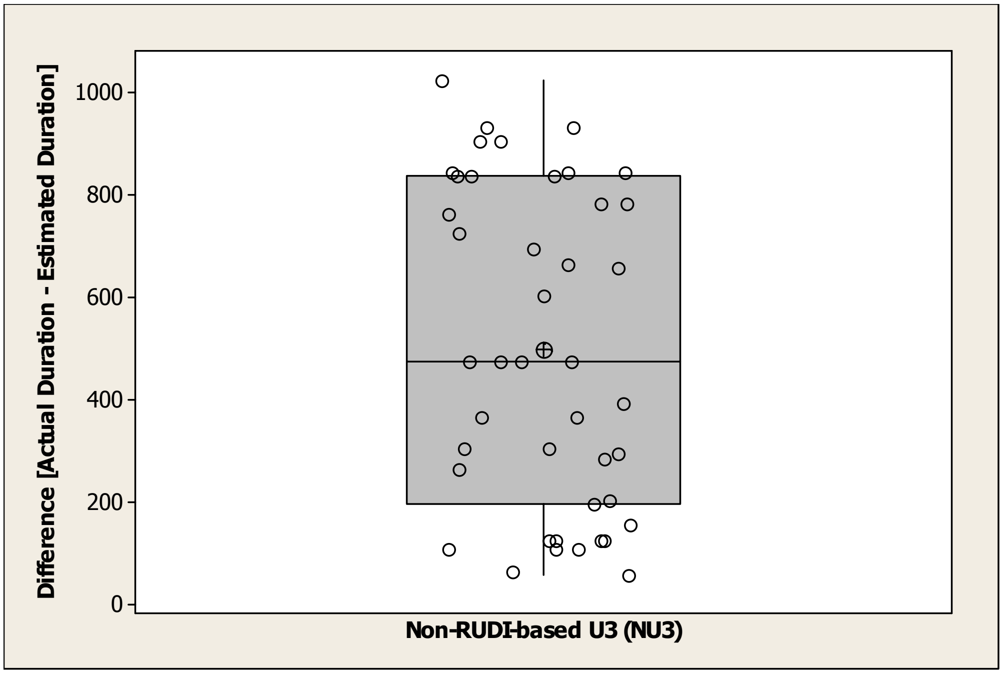


Figure 7.6: Boxplot of Non-RUDI-based U3 (NU3)

Table 7.4 illustrates the accuracy of the non-RUDI-based duration estimation of the utility adjustment process. There were 19 and 17 estimators categorized as More Accurate, respectively, for U1 (R/W Project Release to Final Project Utility Adjustment Agreement Execution) and U3 (from R/W Project Release to Final Project Utility Adjustment Completion). Conversely, there were 16 Less Accurate estimators for both U1 and U3. For U1 and U3, 14 respondents presented more accuracy in estimates for both U1 and U3. In addition, there were 11 Less Accurate estimators for both U1 and U3. The remaining 18 estimators were considered Moderately Accurate estimators because of their inconsistent levels of accuracy.

Table 7.4: Determination of Non-RUDI-based Utility Adjustment Duration Estimation Accuracy

Estr	Utility Adjustment		Accuracy of Estimation	Estr	Utility Adjustment		Accuracy of Estimation
	U1	U3			U1	U3	
E#1	Less	Less	Less Accurate	E#23	More	More	More Accurate
E#2	More	Less	Moderately Accurate	E#24	Less	Less	Less Accurate
E#3	More	Moderately	Moderately Accurate	E#25	More	Moderately	Moderately Accurate
E#4	Moderately	Moderately	Moderately Accurate	E#26	More	Moderately	Moderately Accurate
E#5	Less	More	Moderately Accurate	E#27	Moderately	More	Moderately Accurate
E#6	More	Less	Moderately Accurate	E#28	Less	More	Moderately Accurate
E#7	Less	Less	Less Accurate	E#29	Less	Moderately	Moderately Accurate
E#8	Moderately	Moderately	Moderately Accurate	E#30	Less	Less	Less Accurate
E#9	Less	Less	Less Accurate	E#31	Less	Less	Less Accurate
E#10	Less	Moderately	Moderately Accurate	E#32	More	More	More Accurate
E#11	Less	Moderately	Moderately Accurate	E#33	More	More	More Accurate
E#12	Moderately	Moderately	Moderately Accurate	E#34	More	More	More Accurate
E#13	Moderately	Less	Moderately Accurate	E#35	More	More	More Accurate
E#14	Moderately	Less	Moderately Accurate	E#36	More	More	More Accurate
E#15	Less	Less	Less Accurate	E#37	More	More	More Accurate
E#16	More	More	More Accurate	E#38	Less	Less	Less Accurate
E#17	More	More	More Accurate	E#39	Less	Less	Less Accurate
E#18	More	More	More Accurate	E#40	Less	Less	Less Accurate
E#19	More	More	More Accurate	E#41	More	More	More Accurate
E#20	Moderately	Less	Moderately Accurate	E#42	More	More	More Accurate
E#21	Less	Less	Less Accurate	E#43	Moderately	Moderately	Moderately Accurate
E#22	More	More	More Accurate				

7.2.2.3 Accuracy of RUDI-based Duration Estimations

This section describes the accuracy of RUDI-based duration estimations for R/W acquisition and utility adjustment. The same study participants reported on earlier were asked to estimate the six durations in R/W acquisition and utility adjustment of project B using the RUDI tool. Using the concept addressed earlier, R2 and R3 were focused upon since R1 estimation showed less variability in accuracy and is always the shortest duration among these three durations.

a. Duration of R/W Acquisition

The boxplot illustrated in Figure 7.7 shows that many respondents had difficulties in forecasting R2 (from Initial Appraisal to Possession of Parcel) given that most data points congregate above the first quartile of the data. Outliers in the boxplot are not Less Accurate but More Accurate because these outliers are much closer to zero than any other points. Therefore, these points were designated to be More Accurate estimators.

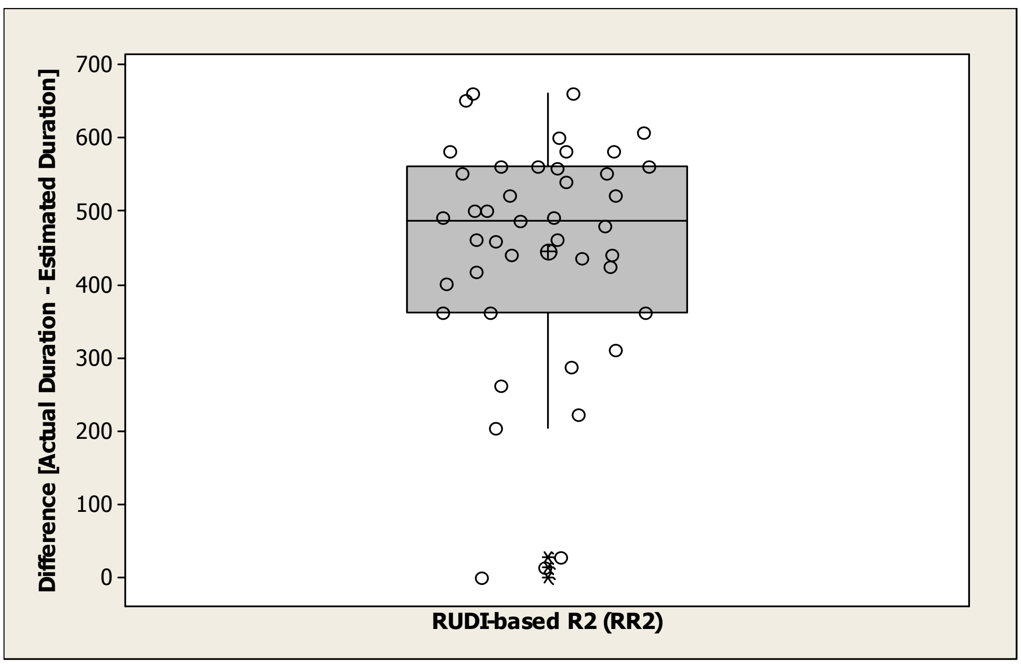


Figure 7.7: Boxplot of RUDI-based R2 (RR2)

As illustrated in Figure 7.8, using the RUDI tool leads to more accurate estimates in predicting R3 (R/W Project Release and Possession of Parcel) when compared to the duration estimation based on judgments because the degree of dispersion of the data points in the box is narrow. The results of the accuracy determination for RR2 and RR3 are described in Table 7.5.

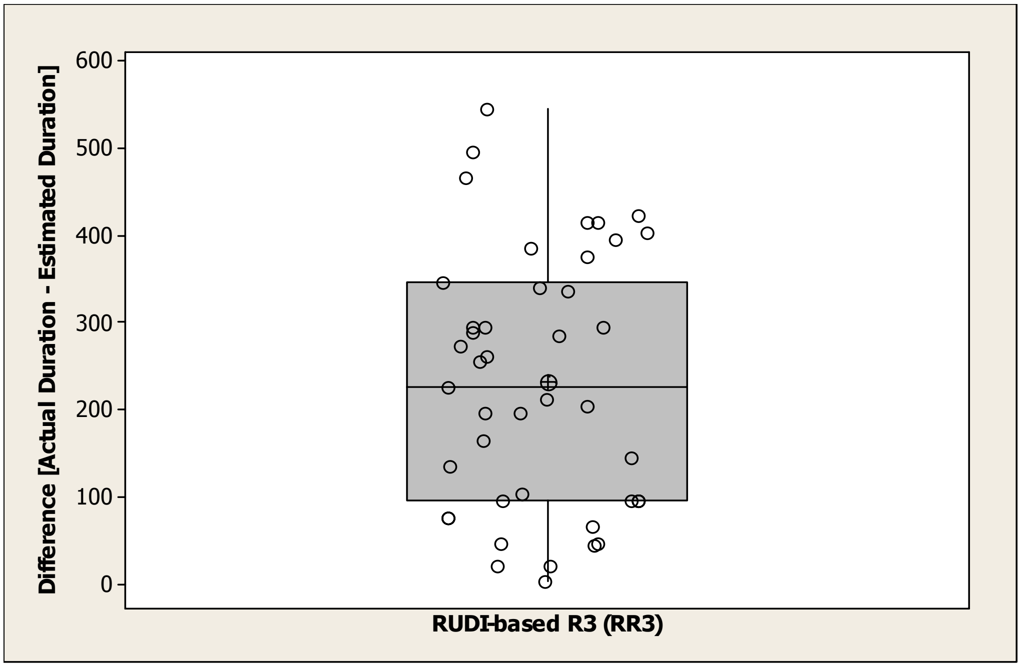


Figure 7.8: Boxplot of RUDI-based R3 (RR3)

As illustrated in Table 7.5, there were 17 and 18 More Accurate estimators for R2 and R3 considered, respectively, when estimators used RUDI as compared to when they did not. As for Less Accurate estimators, 15 and 16 experts were identified for R2 and R3 individually. However, there were only 14 estimators in the More Accurate category in boxplots of both R2 and R3. In contrast, 12 Less Accurate estimators were identified for both R/W durations.

Table 7.5: Determination of RUDI-based R/W Acquisition Duration Estimation Accuracy

Estr	R/W Acquisition		Accuracy of Estimation	Estr	R/W Acquisition		Accuracy of Estimation
	R2	R3			R2	R3	
E#1	Less	Less	Less Accurate	E#23	Moderately	Less	Moderately Accurate
E#2	Less	Less	Less Accurate	E#24	More	More	More Accurate
E#3	More	More	More Accurate	E#25	Moderately	Moderately	Moderately Accurate
E#4	More	More	More Accurate	E#26	More	More	More Accurate
E#5	More	More	More Accurate	E#27	More	More	More Accurate
E#6	Less	Moderately	Moderately Accurate	E#28	Moderately	Moderately	Moderately Accurate
E#7	Less	Less	Less Accurate	E#29	More	Less	Moderately Accurate
E#8	More	Less	Moderately Accurate	E#30	More	More	More Accurate
E#9	Less	Less	Less Accurate	E#31	More	More	More Accurate
E#10	Less	Less	Less Accurate	E#32	Moderately	More	Moderately Accurate
E#11	More	Moderately	Moderately Accurate	E#33	More	More	More Accurate
E#12	Moderately	More	Moderately Accurate	E#34	Moderately	Moderately	Moderately Accurate
E#13	More	More	More Accurate	E#35	More	More	More Accurate
E#14	Less	More	Moderately Accurate	E#36	Less	Less	Less Accurate
E#15	Less	Less	Less Accurate	E#37	Less	Less	Less Accurate
E#16	Less	Less	Less Accurate	E#38	Less	Less	Less Accurate
E#17	Moderately	Moderately	Moderately Accurate	E#39	More	More	More Accurate
E#18	Moderately	Less	Moderately Accurate	E#40	Moderately	Less	Moderately Accurate
E#19	Moderately	More	Moderately Accurate	E#41	Less	Less	Less Accurate
E#20	Moderately	More	Moderately Accurate	E#42	Less	Less	Less Accurate
E#21	More	More	More Accurate	E#43	More	More	More Accurate
E#22	Less	More	Moderately Accurate				

b. Duration of Utility Adjustment

Figures 7.9 and 7.10 depict the degree of difference between the estimated durations and the actual durations of U1 (from R/W Project Release to Final Project Utility Agreement Execution) and U3 (from R/W Project Release to Final Project Utility Adjustment Completion). Although there are some outliers above the fourth quartile, these outliers were not removed from the study because they were considered less accurate estimators. Except for these outliers, most data points are dispersed in the area ranging from zero to approximately 1,000 days.

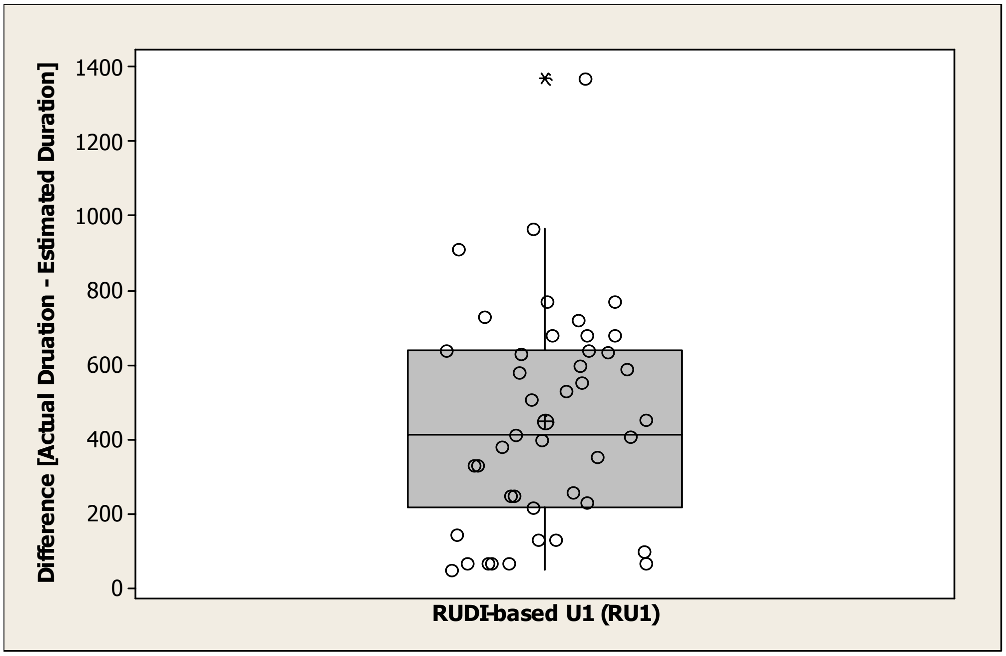


Figure 7.9: Boxplot of RUDI-based U1 (RU1)

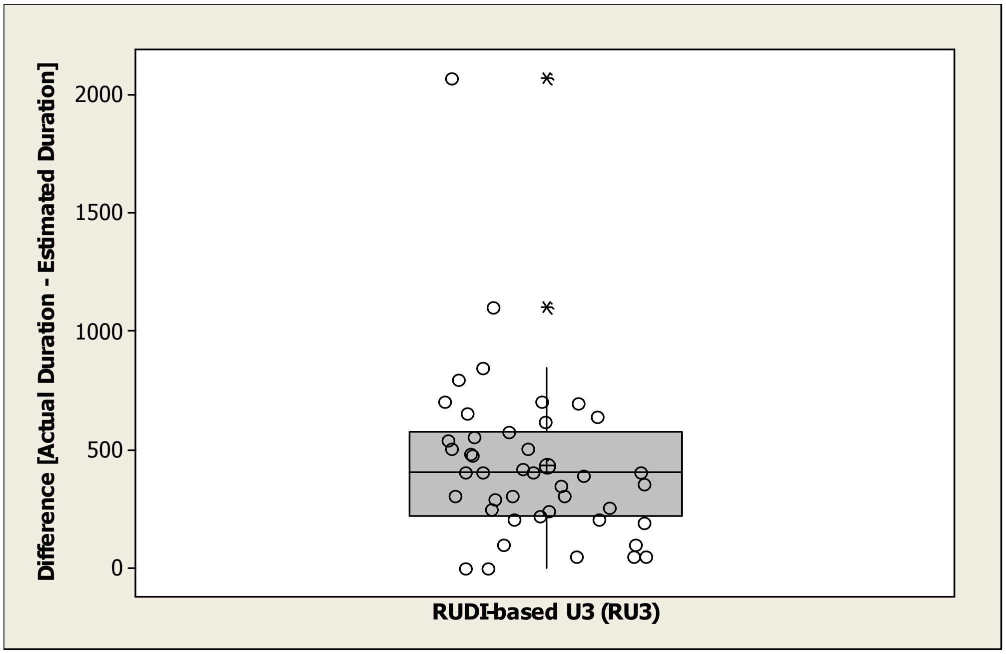


Figure 7.10: Boxplot of RUDI-based U3 (RU3)

As depicted in Table 7.6, there were 17 and 18 More Accurate estimators, respectively, in U1 and U3. In addition, 14 and 16 estimators, respectively, were identified as Less Accurate ones in U1 and U3 individually. When considering accuracy in both U1 and U3, 14 More Accurate and 11 Less Accurate estimators were identified. The remaining 18 were Moderately Accurate estimators; they did not show a consistent level of accuracy in duration estimation across both U1 and U3. These Moderately Accurate estimators were discarded when analyzing the importance of drivers affecting the durations of the utility adjustment based on the assessments of More Accurate and Less Accurate estimators.

Table 7.6: Determination of RUDI-based Utility Adjustment Duration Estimation Accuracy

Estr	Utility Adjustment		Accuracy of Estimation	Estr	Utility Adjustment		Accuracy of Estimation
	U1	U3			U1	U3	
E#1	More	More	More Accurate	E#23	Less	Less	Less Accurate
E#2	Less	Less	Less Accurate	E#24	More	More	More Accurate
E#3	More	More	More Accurate	E#25	More	Moderately	Moderately Accurate
E#4	More	More	More Accurate	E#26	More	More	More Accurate
E#5	More	More	More Accurate	E#27	More	More	More Accurate
E#6	More	More	More Accurate	E#28	More	More	More Accurate
E#7	Moderately	Less	Moderately Accurate	E#29	More	More	More Accurate
E#8	Less	Less	Less Accurate	E#30	More	More	More Accurate
E#9	Moderately	More	Moderately Accurate	E#31	More	More	More Accurate
E#10	Less	Less	Less Accurate	E#32	Moderately	Less	Moderately Accurate
E#11	Moderately	More	Moderately Accurate	E#33	Moderately	Moderately	Moderately Accurate
E#12	Moderately	Moderately	Moderately Accurate	E#34	More	More	More Accurate
E#13	Moderately	Moderately	Moderately Accurate	E#35	Less	Less	Less Accurate
E#14	More	Moderately	Moderately Accurate	E#36	Less	Less	Less Accurate
E#15	Less	Less	Less Accurate	E#37	Less	Less	Less Accurate
E#16	More	Moderately	Moderately Accurate	E#38	Moderately	More	Moderately Accurate
E#17	Less	Less	Less Accurate	E#39	Moderately	Less	Moderately Accurate
E#18	Moderately	Less	Moderately Accurate	E#40	Moderately	Less	Moderately Accurate
E#19	Less	More	Moderately Accurate	E#41	Less	Less	Less Accurate
E#20	Less	Less	Less Accurate	E#42	More	More	More Accurate
E#21	Less	Moderately	Moderately Accurate	E#43	Less	Moderately	Moderately Accurate
E#22	Moderately	Moderately	Moderately Accurate				

7.3 RUDI's Impact on Accuracy of Duration Estimation

As addressed in the introductory section of this dissertation, one of the objectives of this implementation research project was to test the accuracy of the RUDI tool and then to see if use of RUDI improved the accuracy of duration estimations. This two-fold objective was achieved by comparing non-RUDI-based and RUDI-based duration estimations.

7.3.1 Comparison between Non-RUDI and RUDI-based Durations

This section compares the accuracy of non-RUDI-based and RUDI-based duration estimations. Through this comparative analysis, it is possible to see if, and if yes, how much, RUDI improved the accuracy when compared to non-RUDI-based duration estimations.

7.3.1.1 R/W Acquisition Durations

For R2, non-RUDI-based durations are more accurate than RUDI-based durations as depicted in Figure 7.11. The data show that while some individual data points in the boxplot for NR2 are close to zero, most data points in the boxplot for RR2 are far from zero. This result means that the non-RUDI-based R2 durations were relatively more accurate as compared to the RUDI-based durations.

RUDI-based durations were derived from recommended percentile ranges based on the degree of schedule urgency and uncertainty. These parameters that are hard to control for may have introduced large differences in the accuracy of predictions. In other words, different judgments about the project's degree of uncertainty and schedule urgency may have caused inaccurate estimates. Another possible reason for the discrepancy is that project B is poorly represented among the RUDI R/W data.

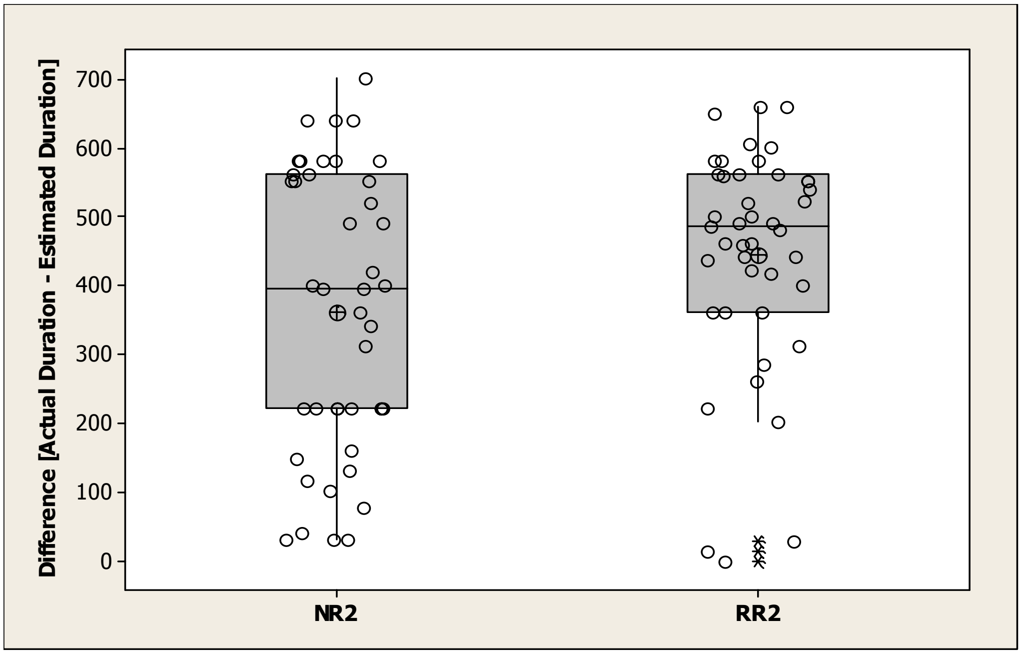


Figure 7.11: Boxplot of Non-RUDI and RUDI-based: R2

Table 7.7 illustrates RUDI's utility in improving the accuracy of non-RUDI-based duration estimations of R2 in terms of individual estimators. Although RUDI was helpful for 12 estimators in predicting the duration of R2, improving the accuracy of their predictions, the accuracy of 15 estimators' predictions was negatively impacted by using RUDI. As mentioned in the description of Figure 7.11, because RUDI-based estimates were not as accurate for R2 compared to non-RUDI-based duration estimation, RUDI was not helpful in improving accuracy.

However, there was a distinctive trend that appears to be prevalent among the estimators who gained accuracy improvements through the use of RUDI. The type of district of 11 out of 12 of these estimators was Rural. In terms of this apparent trend, experts working from Rural Districts in TxDOT appear to possess more chances to improve their estimation accuracy when using the RUDI tool as compared to experts from other types of districts. In other words, RUDI could be used as an effective information assistance tool for local districts located in rural areas because the data stored in RUDI provide experts involved in Rural Districts with the guidance needed in predicting durations for R/W acquisition. However, employing this finding should be limited because only one highway project was estimated by practitioners.

Conversely, ten out of 15 estimators who did not get better accuracy for their estimations by using the RUDI tool were from Urban or Metropolitan districts. This trend implies that the use of RUDI may have negatively influenced the duration estimation of experts from Urban / Metropolitan districts who already have shown relatively high accuracy in the non-RUDI-based duration estimation. In other words, due to limited drivers utilized in RUDI, More Accurate experts may have had difficulties in making final decisions based on the duration ranges provided by RUDI.

Table 7.7: Comparison between Non-RUDI and RUDI-based Duration: R2

Estr.	Backgrounds of Experts			R/W Acquisition: R2		RUDI Improved Accuracy? (Y/N)	Estr.	Backgrounds of Experts			R/W Acquisition: R2		RUDI Improved Accuracy? (Y/N)
	Years of Experience	Areas of Expertise	Types of District	Non-RUDI	RUDI			Years of Experience	Areas of Expertise	Types of District	Non-RUDI	RUDI	
E#1	< 13	Utility	Rural	Less	Less	Same	E#23	> 13	R/W	Urban/Metro.	More	Moderately	No
E#2	> 13	R/W	Rural	Moderately	Less	No	E#24	< 13	Utility	Rural	Less	More	Yes
E#3	< 13	R/W	Rural	More	More	Same	E#25	< 13	R/W	Rural	Less	Moderately	Yes
E#4	> 13	R/W	Rural	More	More	Same	E#26	> 13	R/W	Rural	More	More	Same
E#5	> 13	R/W	Rural	More	More	Same	E#27	> 13	Utility	Rural	More	More	Same
E#6	> 13	R/W	Rural	Less	Less	Same	E#28	< 13	R/W	Rural	More	Moderately	No
E#7	> 13	R/W	Rural	Moderately	Less	No	E#29	> 13	R/W	Rural	Moderately	More	Yes
E#8	> 13	Utility	Rural	More	More	Same	E#30	> 13	R/W	Rural	Less	More	Yes
E#9	< 13	Utility	Rural	Less	Less	Same	E#31	< 13	Utility	Rural	Moderately	More	Yes
E#10	< 13	Utility	Rural	Less	Less	Same	E#32	< 13	Utility	Rural	Less	Moderately	Yes
E#11	< 13	Utility	Urban/Metro.	Less	More	Yes	E#33	> 13	Utility	Rural	Less	More	Yes
E#12	> 13	R/W	Urban/Metro.	More	Moderately	No	E#34	< 13	R/W	Rural	More	Moderately	No
E#13	> 13	R/W	Rural	Less	More	Yes	E#35	< 13	Utility	Rural	Less	More	Yes
E#14	< 13	R/W	Urban/Metro.	Moderately	Less	No	E#36	> 13	R/W	Urban/Metro.	More	Less	No
E#15	> 13	R/W	Urban/Metro.	Less	Less	Same	E#37	< 13	Utility	Urban/Metro.	Less	Less	Same
E#16	> 13	R/W	Urban/Metro.	Moderately	Less	No	E#38	< 13	R/W	Rural	Less	Less	Same
E#17	< 13	Utility	Urban/Metro.	More	Moderately	No	E#39	> 13	R/W	Rural	More	More	Same
E#18	> 13	Utility	Urban/Metro.	More	Moderately	No	E#40	< 13	Utility	Rural	Less	Moderately	Yes
E#19	< 13	Utility	Urban/Metro.	More	Moderately	No	E#41	< 13	Utility	Urban/Metro.	Less	Less	Same
E#20	> 13	R/W	Urban/Metro.	More	Moderately	No	E#42	> 13	R/W	Rural	Moderately	Less	No
E#21	< 13	Utility	Urban/Metro.	More	More	Same	E#43	> 13	R/W	Rural	Moderately	More	Yes
E#22	< 13	R/W	Urban/Metro.	More	Less	No							

For R3, RUDI-based duration estimations were more accurate than non-RUDI-based duration estimations, as presented in Figure 7.12. The data in the boxplot for NR3 were widely spread, while the RR3 data showed a more narrow degree of dispersion in the boxplot. This result means that most estimators benefited from using RUDI when estimating the durations for R3. Moreover, because R3 covers the entire R/W acquisition process (from R/W Project Release to Possession of Parcel), the negative impact of the inaccurate numbers for R2 may be offset by the more accurate R3 duration estimations. R3 is the more significant estimation time period for R/W acquisition of highway projects overall because it encompasses the whole process.

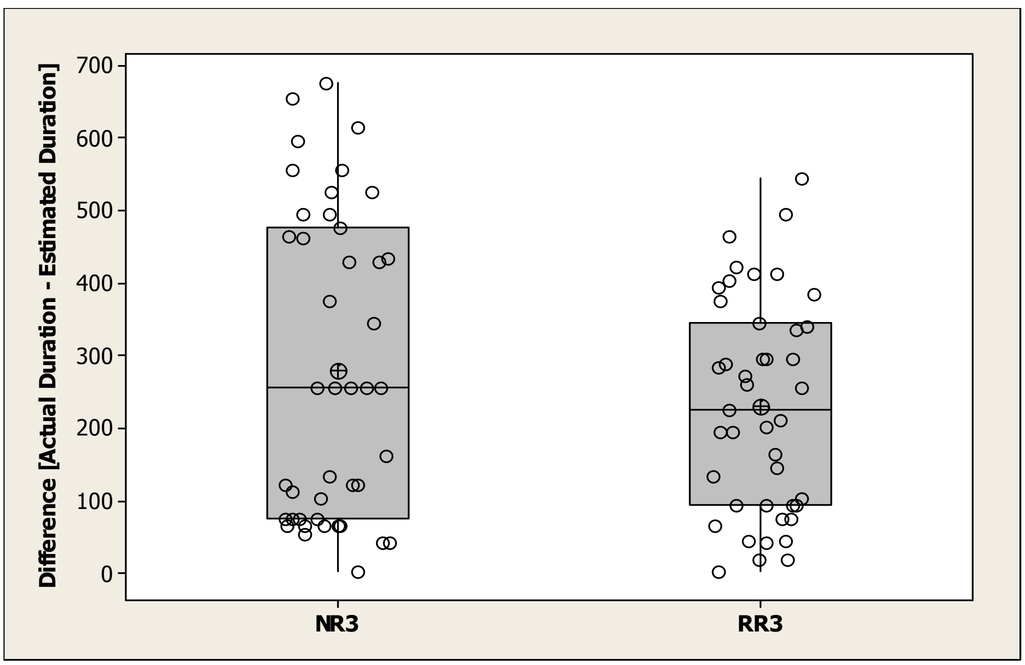


Figure 7.12: Boxplot of Non-RUDI and RUDI-based: R3

Table 7.8 shows that there were 11 estimators with improved accuracy for R3 when using RUDI, and there were 11 estimators with worse accuracy. The remaining 21 estimators did not show significant changes in the accuracy of their duration estimations. However, as described in Figure 7.12, the overall accuracy of RUDI-based R3 duration estimations was better than non-RUDI-based R3 duration estimations.

Along with the influence of RUDI on the accuracy of R2 duration estimation based on judgments, one of the trends that appeared in the duration of R2 was again observed again among estimators who obtained improved accuracy for the R3 duration through the use of RUDI. Specifically, eight out of 11 experts who improved the accuracy of RUDI-based R3 durations were involved in Rural Districts. However, most practitioners who did not benefit from use of RUDI were also from Rural Districts. Based on this inconsistent pattern, it is difficult to conclude that the RUDI tool is effective in helping practitioners at the districts located in rural areas. That is, employing the trend shown in the duration of R2, which is defined as the duration from initial appraisal to possession of parcel, should be restricted because only a single project was utilized in this study.

Table 7.8: Comparison between Non-RUDI and RUDI-based Duration: R3

Estr.	Backgrounds of Experts			R/W Acquisition: R3		RUDI Improved Accuracy? (Y/N)	Estr.	Backgrounds of Experts			R/W Acquisition: R3		RUDI Improved Accuracy? (Y/N)
	Years of Experience	Areas of Expertise	Types of District	Non-RUDI	RUDI			Years of Experience	Areas of Expertise	Types of District	Non-RUDI	RUDI	
E#1	< 13	Utility	Rural	Less	Less	Same	E#23	> 13	R/W	Urban/Metro.	More	Less	No
E#2	> 13	R/W	Rural	Less	Less	Same	E#24	< 13	Utility	Rural	Less	More	Yes
E#3	< 13	R/W	Rural	More	More	Same	E#25	< 13	R/W	Rural	Moderately	Moderately	Same
E#4	> 13	R/W	Rural	More	More	Same	E#26	> 13	R/W	Rural	More	More	Same
E#5	> 13	R/W	Rural	More	More	Same	E#27	> 13	Utility	Rural	More	More	Same
E#6	> 13	R/W	Rural	More	Moderately	No	E#28	< 13	R/W	Rural	More	Moderately	No
E#7	> 13	R/W	Rural	Less	Less	Same	E#29	> 13	R/W	Rural	More	Less	No
E#8	> 13	Utility	Rural	More	Less	No	E#30	> 13	R/W	Rural	Less	More	Yes
E#9	< 13	Utility	Rural	Less	Less	Same	E#31	< 13	Utility	Rural	Less	More	Yes
E#10	< 13	Utility	Rural	Less	Less	Same	E#32	< 13	Utility	Rural	Less	More	Yes
E#11	< 13	Utility	Urban/Metro.	Moderately	Moderately	Same	E#33	> 13	Utility	Rural	Less	More	Yes
E#12	> 13	R/W	Urban/Metro.	More	More	Same	E#34	< 13	R/W	Rural	More	Moderately	No
E#13	> 13	R/W	Rural	Moderately	More	Yes	E#35	< 13	Utility	Rural	Less	More	Yes
E#14	< 13	R/W	Urban/Metro.	Less	More	Yes	E#36	> 13	R/W	Urban/Metro.	Moderately	Less	No
E#15	> 13	R/W	Urban/Metro.	Less	Less	Same	E#37	< 13	Utility	Urban/Metro.	Less	Less	Same
E#16	> 13	R/W	Urban/Metro.	More	Less	No	E#38	< 13	R/W	Rural	Less	Less	Same
E#17	< 13	Utility	Urban/Metro.	Moderately	Moderately	Same	E#39	> 13	R/W	Rural	More	More	Same
E#18	> 13	Utility	Urban/Metro.	More	Less	No	E#40	< 13	Utility	Rural	More	Less	No
E#19	< 13	Utility	Urban/Metro.	Moderately	More	Yes	E#41	< 13	Utility	Urban/Metro.	Less	Less	Same
E#20	> 13	R/W	Urban/Metro.	More	More	Same	E#42	> 13	R/W	Rural	More	Less	No
E#21	< 13	Utility	Urban/Metro.	Moderately	More	Yes	E#43	> 13	R/W	Rural	Moderately	More	Yes
E#22	< 13	R/W	Urban/Metro.	More	More	Same							

7.3.1.2 Utility Adjustment Durations

The data show that for U1, RUDI-based durations were more accurate than non-RUDI-based ones, as depicted in Figure 7.13. The figure shows that the dispersion of the RUDI-based U1 durations was tighter than that of the non-RUDI based U1 durations. The data for NU1 were roughly divided into two groups based on whether their estimations deviated from the actual duration by approximately more or less than approximately 500 days, which are close to the More Accurate zone. That is, more than half of the estimators produced numbers with more than about 500 days difference from the actual duration. Although RUDI did not include a large sample of information for utility adjustment, the collected sample for RUDI provided a reasonable amount of duration information to the estimators.

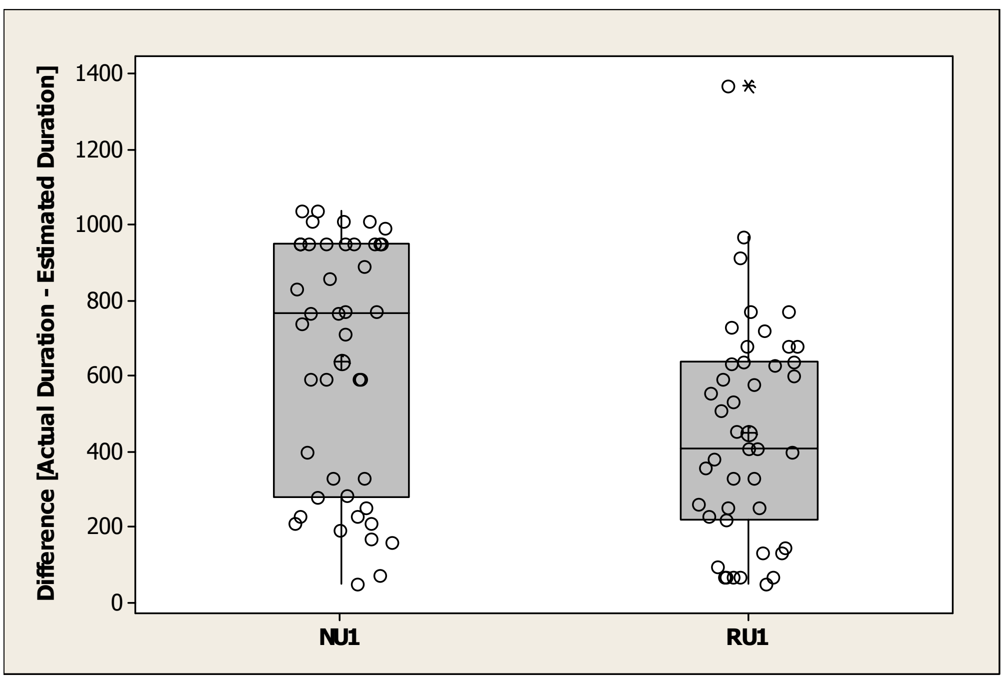


Figure 7.13: Boxplot of Non-RUDI and RUDI-based: U1

As illustrated in Table 7.9, there were 16 estimators who demonstrated improvements in accuracy for U1 when using RUDI. Conversely, RUDI decreased the accuracy of 15 estimators from more to less accurate, from more to moderately, or from moderately to less accurate.

Similar to the durations of R2 and R3, most experts with improved accuracy through the use of RUDI were from the districts located in rural areas. Conversely, nine out of 15 estimators who did not benefit from RUDI were from Urban / Metropolitan districts. Even though the reliability of the results should be improved, RUDI could be an effective tool for practitioners who predict durations needed for adjusting or relocating utilities based on the limited resources of their Rural Districts.

Table 7.9: Comparison between Non-RUDI and RUDI-based Duration: U1

Estr.	Backgrounds of Experts			R/W Acquisition: U1		RUDI Improved Accuracy? (Y/N)	Estr.	Backgrounds of Experts			R/W Acquisition: U1		RUDI Improved Accuracy? (Y/N)
	Years of Experience	Areas of Expertise	Types of District	Non-RUDI	RUDI			Years of Experience	Areas of Expertise	Types of District	Non-RUDI	RUDI	
E#1	< 13	Utility	Rural	Less	More	Yes	E#23	> 13	R/W	Urban/Metro.	More	Less	No
E#2	> 13	R/W	Rural	More	Less	No	E#24	< 13	Utility	Rural	Less	More	Yes
E#3	< 13	R/W	Rural	More	More	Same	E#25	< 13	R/W	Rural	More	More	Same
E#4	> 13	R/W	Rural	Moderately	More	Yes	E#26	> 13	R/W	Rural	More	More	Same
E#5	> 13	R/W	Rural	Less	More	Yes	E#27	> 13	Utility	Rural	Moderately	More	Yes
E#6	> 13	R/W	Rural	More	More	Same	E#28	< 13	R/W	Rural	Less	More	Yes
E#7	> 13	R/W	Rural	Less	Moderately	Yes	E#29	> 13	R/W	Rural	Less	More	Yes
E#8	> 13	Utility	Rural	Moderately	Less	No	E#30	> 13	R/W	Rural	Less	More	Yes
E#9	< 13	Utility	Rural	Less	Moderately	Yes	E#31	< 13	Utility	Rural	Less	More	Yes
E#10	< 13	Utility	Rural	Less	Less	Same	E#32	< 13	Utility	Rural	More	Moderately	No
E#11	< 13	Utility	Urban/Metro.	Less	Moderately	Yes	E#33	> 13	Utility	Rural	More	Moderately	No
E#12	> 13	R/W	Urban/Metro.	Moderately	Moderately	Same	E#34	< 13	R/W	Rural	More	More	Same
E#13	> 13	R/W	Rural	Moderately	Moderately	Same	E#35	< 13	Utility	Rural	More	Less	No
E#14	< 13	R/W	Urban/Metro.	Moderately	More	Yes	E#36	> 13	R/W	Urban/Metro.	More	Less	No
E#15	> 13	R/W	Urban/Metro.	Less	Less	Same	E#37	< 13	Utility	Urban/Metro.	More	Less	No
E#16	> 13	R/W	Urban/Metro.	More	More	Same	E#38	< 13	R/W	Rural	Less	Moderately	Yes
E#17	< 13	Utility	Urban/Metro.	More	Less	No	E#39	> 13	R/W	Rural	Less	Moderately	Yes
E#18	> 13	Utility	Urban/Metro.	More	Moderately	No	E#40	< 13	Utility	Rural	Less	Moderately	Yes
E#19	< 13	Utility	Urban/Metro.	More	Less	No	E#41	< 13	Utility	Urban/Metro.	More	Less	No
E#20	> 13	R/W	Urban/Metro.	Moderately	Less	No	E#42	> 13	R/W	Rural	More	More	Same
E#21	< 13	Utility	Urban/Metro.	Less	Less	Same	E#43	> 13	R/W	Rural	Moderately	Less	No
E#22	< 13	R/W	Urban/Metro.	More	Moderately	No							

For U3, RUDI-based durations were also slightly more accurate than non-RUDI-based durations, even though there were some extreme outliers in the boxplot for RU3 as described in Figure 7.14.

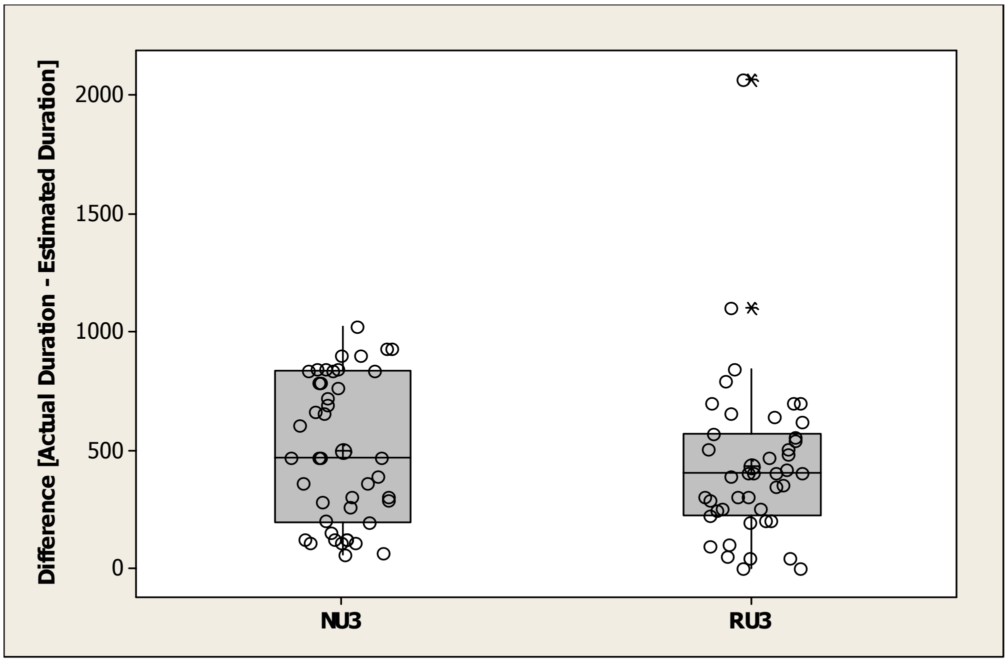


Figure 7.14: Boxplot of Non-RUDI and RUDI-based Duration: U3

There were 15 estimators with improved accuracy in using RUDI for U3, while 13 estimators did not benefit from the RUDI application in their estimates as indicated in Table 7.10. The remaining 15 estimators did not exhibit significant differences between their non-RUDI-based and RUDI-based duration estimations for U3. In addition, similar to the trend shown in the duration estimation of U3, most experts who obtained improved accuracy through using RUDI for their estimation were working in Rural Districts. However, eight out of 13 estimators who did not benefit from the RUDI application were from the districts located in urban or metropolitan areas.

Table 7.10: Comparison between Non-RUDI and RUDI-based Duration: U3

Estr.	Backgrounds of Experts			R/W Acquisition: U3		RUDI Improved Accuracy? (Y/N)	Estr.	Backgrounds of Experts			R/W Acquisition: U3		RUDI Improved Accuracy? (Y/N)
	Years of Experience	Areas of Expertise	Types of District	Non-RUDI	RUDI			Years of Experience	Areas of Expertise	Types of District	Non-RUDI	RUDI	
E#1	< 13	Utility	Rural	Less	More	Yes	E#23	> 13	R/W	Urban/Metro.	More	Less	No
E#2	> 13	R/W	Rural	Less	Less	Same	E#24	< 13	Utility	Rural	Less	More	Yes
E#3	< 13	R/W	Rural	Moderately	More	Yes	E#25	< 13	R/W	Rural	Moderately	Moderately	Same
E#4	> 13	R/W	Rural	Moderately	More	Yes	E#26	> 13	R/W	Rural	Moderately	More	Yes
E#5	> 13	R/W	Rural	More	More	Same	E#27	> 13	Utility	Rural	More	More	Same
E#6	> 13	R/W	Rural	Less	More	Yes	E#28	< 13	R/W	Rural	More	More	Same
E#7	> 13	R/W	Rural	Less	Less	Same	E#29	> 13	R/W	Rural	Moderately	More	Yes
E#8	> 13	Utility	Rural	Moderately	Less	No	E#30	> 13	R/W	Rural	Less	More	Yes
E#9	< 13	Utility	Rural	Less	More	Yes	E#31	< 13	Utility	Rural	Less	More	Yes
E#10	< 13	Utility	Rural	Moderately	Less	No	E#32	< 13	Utility	Rural	More	Less	No
E#11	< 13	Utility	Urban/Metro.	Moderately	More	Yes	E#33	> 13	Utility	Rural	More	Moderately	No
E#12	> 13	R/W	Urban/Metro.	Moderately	Moderately	Same	E#34	< 13	R/W	Rural	More	More	Same
E#13	> 13	R/W	Rural	Less	Moderately	Yes	E#35	< 13	Utility	Rural	More	Less	No
E#14	< 13	R/W	Urban/Metro.	Less	Moderately	Yes	E#36	> 13	R/W	Urban/Metro.	More	Less	No
E#15	> 13	R/W	Urban/Metro.	Less	Less	Same	E#37	< 13	Utility	Urban/Metro.	More	Less	No
E#16	> 13	R/W	Urban/Metro.	More	Moderately	No	E#38	< 13	R/W	Rural	Less	More	Yes
E#17	< 13	Utility	Urban/Metro.	More	Less	No	E#39	> 13	R/W	Rural	Less	Less	Same
E#18	> 13	Utility	Urban/Metro.	More	Less	No	E#40	< 13	Utility	Rural	Less	Less	Same
E#19	< 13	Utility	Urban/Metro.	More	More	Same	E#41	< 13	Utility	Urban/Metro.	More	Less	No
E#20	> 13	R/W	Urban/Metro.	Less	Less	Same	E#42	> 13	R/W	Rural	More	More	Same
E#21	< 13	Utility	Urban/Metro.	Less	Moderately	Yes	E#43	> 13	R/W	Rural	Moderately	Moderately	Same
E#22	< 13	R/W	Urban/Metro.	More	Moderately	No							

As the previous tables describing RUDI's usefulness in predicting durations for R/W acquisition and utility adjustment illustrate, RUDI was useful in improving the accuracy of non-RUDI-based duration estimation of practitioners from Rural Districts. One of the possible reasons for this performance of RUDI in the R/W acquisition duration estimation could be that 151 out of the 193 original projects used in constructing the R/W acquisition durations in the tool were delivered by regional districts located in rural areas. In other words, since most of the advisory data from the RUDI tool was heavily based on the analysis of rural districts' projects, the applicability of the duration ranges represented by RUDI is highly relevant to practitioners from Rural Districts as compared to ones from Urban / Metropolitan Districts.

In contrast, for utility adjustment duration, 24 and 43 projects were collected from rural and urban/metropolitan districts, respectively. Even though rural districts' projects were not the majority in developing the advisory data of utility adjustment durations, practitioners from Rural Districts exhibited improved accuracy when using RUDI for their estimation of utility adjustment. The explanation for this pattern could be found in the way utility projects were collected. Utility projects were solicited by a district office survey asking practitioners to identify projects that were considered either "quick" or "slow" rather than through a random selection process from ROWIS. This data collection method led the research team to have an envelope shape of data with boundaries representing the most extreme project derived from projects considered either quick or slow. Therefore, the advisory data provided by RUDI for utility adjustment duration could have higher reliability as compared to the data of R/W acquisition durations.

7.4 ASSESSMENTS OF DURATION DRIVER IMPORTANCE

While the previous section discussed the accuracy of duration estimations, this section describes the results of the importance assessments of drivers that affect the durations of the R/W acquisition and utility adjustment processes. As mentioned in the data collection, there were two ways of assigning importance to drivers: PRE-application and POST-application. Using three independent variables including practitioners' years of experience, types of district, and areas of expertise, these drivers' levels of importance were analyzed to observe the impacts of various backgrounds of practitioners on assessing the driver importance.

7.4.1 PRE-Application Importance of Duration Drivers

Before experts were asked to estimate the durations of the R/W acquisition and utility adjustment of project B, they were all asked to assess the PRE-application importance level of 42 duration drivers using a 4-point Likert scale. The scale's points were labeled "not important" with a value of (0), "low importance" with a value of (0.33), "moderate importance" with a value of (0.67), and "high importance" with a value of (1). For this driver importance evaluation, any specific information about project characteristics was not given to study participants so as not to introduce bias.

7.4.1.1 All Respondents

The respondents ranked the PRE-application importance level of the 42 drivers from 0.891 to 0.597, as depicted in Table 7.11. Specifically, drivers #4 (Right-of-Way and Utility Scope), #7 (Status of Environmental Clearance) and #8 (Status of Right-of-Way Map) related to the Project Basic Facts category were evaluated as having relatively high importance by the estimators. They ranked these among the top ten most highly rated drivers. Driver #7 in particular was perceived by most respondents to be the most important driver. Among R/W Acquisition-related drivers, drivers #19 (Number of Parcels for Acquisition), #21 (Frequency of Eminent Domain), and #28 (Need for Residential Relocation) also ranked in the top ten. For Utility Adjustment, there were four drivers ranked in the top ten. These include drivers #37 (Number of Utilities Located in Public R/W), #38 (Number of Utilities Located in Private Easement), #39 (Number of Utilities for Adjustments or Relocations), and #41 (Responsiveness of Utility Companies to TxDOT Needs).

Table 7.11: Descriptive Statistics of PRE-Application Importance Assessments

Category	Driver	Description	Mean (n=43)	Rank
Project Basic Facts	D1	TxDOT Project Type	0.767	18
	D2	TxDOT Highway Type	0.690	31
	D3	Project Location Type	0.674	35
	D4	Right-of-Way and Utility Scope	0.822	9
	D5	Status of Schematic Design	0.651	37
	D6	Status of Boundary Surveying	0.705	27
	D7	Status of Environmental Clearance	0.891	1
	D8	Status of Right-of-Way Map	0.860	4
	D9	Internal R/W Staff Size of a District	0.690	31
	D10	District R/W Annual Budget	0.721	24
	D11	Dedication of Funds to the Project (R/W and Construction)	0.783	14
	D12	LPA Funded or Non-LPA Funded	0.674	34
	D13	Federally Funded or Non-Federally Funded	0.659	36
	D14	Funding Limitations for the Project	0.775	16
	D15	Level of Acceptance of the Project by the Public	0.705	26
	D16	Level of Political Pressure	0.636	41
	D17	Common Concerns of Property Owners	0.729	23
	D18	Current Status of the R/W Project	0.791	12
R/W Acquisition	D19	Number of Parcels for Acquisition	0.845	7
	D20	Different Types of Parcel Usages	0.705	27
	D21	Frequency of Eminent Domain	0.860	5
	D22	Source of Personnel to be used for R/W Acquisition	0.690	33
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.713	25
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.698	30
	D25	Type of Property Owners	0.643	40
	D26	Level of Familiarity with Key Landowners	0.597	42
	D27	Are There Any Property Tenants to Consider?	0.736	22
	D28	Need for Residential Relocation	0.814	10
	D29	Level of Local Availability of Replacement Housing Facilities	0.760	19
	D30	Need for Business Relocation	0.760	19
	D31	Level of Local Availability of Replacement Business Facilities	0.783	14
	D32	Likelihood of Title Curative Actions	0.791	12
	D33	Responsiveness of Local Title Companies to TxDOT	0.760	19
Utility Adjustment	D34	Have SUE Investigations Been Performed?	0.643	39
	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.651	37
	D36	Utility Type	0.806	11
	D37	Number of Utilities Located in Public R/W	0.829	8
	D38	Number of Utilities Located in Private Easement	0.876	3
	D39	Number of Utilities for Adjustments or Relocations	0.860	6
	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.698	29
	D41	Responsiveness of Utility Companies to TxDOT Needs	0.884	2
	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.775	16

7.4.1.2 Analysis Using Practitioners' Backgrounds

The following three tables describe the results of the PRE-application importance of 42 duration drivers on the basis of respondents' backgrounds expressed in three ways as described above: (1) years of experience; (2) areas of expertise; and (3) types of district.

First, two groupings of years of experience were used: (1) Most Experienced, and (2) Least Experienced. Estimators with less than 13 years of experience were defined as the "Least Experienced." Respondents with more than 13 years of experience were designated as the "Most Experienced."

This analysis was intended to examine differences between the Most and Least Experienced estimators' assessments of the PRE-application importance of duration drivers. A comparative analysis was conducted, and as depicted in Table 7.12 the rankings were based on the differences (interpreted in absolute values) between the two groups. Some differences are expressed as negative numbers, and these numbers indicate a shift between Most and Least Experienced. More specifically, 25 out of the 42 drivers were evaluated as having a relatively high importance by respondents with more than 13 years of experienced when compared to the Least Experienced respondents. Conversely, 17 drivers were considered as having a relatively high level of importance by those with less experience when they were compared to the Most Experienced estimators. In addition, there were only two drivers showing large differences exceeding the cut-off (> 0.2): #10 (District R/W Annual Budget) and #13 (Federally Funded or Non-Federally Funded). In other words, the Most Experienced experts did not recognize the size of a district's R/W annual budget as a critical issue when estimating the durations of the R/W acquisition and utility adjustment. In contrast, this driver was considered an important factor by most of the Least Experienced experts. For driver #13, the Most Experienced practitioners indicated that federal funding may be a critical factor in predicting the R/W acquisition and utility adjustment durations.

In order to investigate the impact of years of experience on these differences in assessing the importance of duration drivers, another comparative analysis using a chi-square test was conducted. The results of this analysis are described in the following sections.

Table 7.12: PRE-Application Importance of Drivers: Most vs. Least Experienced Practitioners

Category	Driver	Description	PRE-Application Most Experienced (n=22)	PRE-Application Least Experienced (n=21)	Difference	Rank
Project Basic Facts	D1	TxDOT Project Type	0.788	0.746	0.042	30
	D2	TxDOT Highway Type	0.727	0.651	0.076	12
	D3	Project Location Type	0.667	0.683	– 0.016	36
	D4	Right-of-Way and Utility Scope	0.818	0.825	– 0.007	39
	D5	Status of Schematic Design	0.621	0.683	– 0.061	20
	D6	Status of Boundary Surveying	0.652	0.762	– 0.110	3
	D7	Status of Environmental Clearance	0.924	0.857	0.067	19
	D8	Status of Right-of-Way Map	0.833	0.889	– 0.056	25
	D9	Internal R/W Staff Size of a District	0.636	0.746	– 0.110	3
	D10	District R/W Annual Budget	0.621	0.825	– 0.204	1
	D11	Dedication of Funds to the Project (R/W and Construction)	0.833	0.730	0.103	6
	D12	LPA Funded or Non-LPA Funded	0.727	0.619	0.108	5
	D13	Federally Funded or Non-Federally Funded	0.758	0.556	0.202	2
	D14	Funding Limitations for the Project	0.818	0.730	0.088	9
	D15	Level of Acceptance of the Project by the Public	0.727	0.683	0.045	27
	D16	Level of Political Pressure	0.621	0.651	– 0.030	34
	D17	Common Concerns of Property Owners	0.712	0.746	– 0.034	33
	D18	Current Status of the R/W Project	0.758	0.825	– 0.068	17
R/W Acquisition	D19	Number of Parcels for Acquisition	0.864	0.825	0.038	31
	D20	Different Types of Parcel Usages	0.742	0.667	0.076	12
	D21	Frequency of Eminent Domain	0.879	0.841	0.038	31
	D22	Source of Personnel to be used for R/W Acquisition	0.712	0.667	0.045	27
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.742	0.683	0.060	24
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.727	0.667	0.061	20
	D25	Type of Property Owners	0.621	0.667	– 0.045	27
	D26	Level of Familiarity with Key Landowners	0.606	0.587	0.019	35
	D27	Are There Any Property Tenants to Consider?	0.742	0.730	0.012	37
	D28	Need for Residential Relocation	0.848	0.778	0.071	15
	D29	Level of Local Availability of Replacement Housing Facilities	0.803	0.714	0.089	7
	D30	Need for Business Relocation	0.758	0.762	– 0.004	42
	D31	Level of Local Availability of Replacement Business Facilities	0.742	0.825	– 0.083	10
	D32	Likelihood of Title Curative Actions	0.818	0.762	0.056	25
	D33	Responsiveness of Local Title Companies to TxDOT	0.803	0.714	0.089	7
Utility Adjustment	D34	Have SUE Investigations Been Performed	0.606	0.683	– 0.076	12
	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.621	0.683	– 0.061	20
	D36	Utility Type	0.803	0.810	– 0.006	40
	D37	Number of Utilities Located in Public R/W	0.833	0.825	0.008	38
	D38	Number of Utilities Located in Private Easement	0.909	0.841	0.068	17
	D39	Number of Utilities for Adjustments or Relocations	0.894	0.825	0.069	16
	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.727	0.667	0.061	20
	D41	Responsiveness of Utility Companies to TxDOT Needs	0.924	0.841	0.083	10
	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.773	0.778	– 0.005	41

Along with respondents' years of experience, another independent variable used in analyzing the PRE-application importance rankings of duration drivers was respondents' areas of expertise. As mentioned earlier, the study's participants were grouped into two categories based on whether they specialized in R/W Acquisition or Utility Adjustment.

As Table 7.13 illustrates, there were no drivers with large differences (> 0.2) in the comparative assessment. However, 16 out of 42 drivers were considered to have relatively high importance according to the Utility practitioners in particular, as compared to the R/W practitioners' assessments of these drivers' importance. Conversely, 26 drivers were deemed to be relatively highly important by R/W practitioners, as compared to the Utility practitioners' assessments.

Another finding this table shows is that areas of expertise may not be factors that bring about significant differences between R/W and Utility practitioners in evaluating the PRE-application importance of duration drivers. However, similar to the results of the analysis involving years of experience, this finding did not prove to be statistically important. In order to validate it, therefore, a chi-square test was used. The list of drivers that did have statistical importance is described in the following sections.

Table 7.13: PRE-Application Importance of Drivers: R/W Experts vs. Utility Practitioners

Category	Driver	Description	PRE-Application R/W Expert (n=25)	PRE-Application Utility Expert (n=18)	Difference (R-U)	Rank
Project Basic Facts	D1	TxDOT Project Type	0.813	0.704	0.109	6
	D2	TxDOT Highway Type	0.720	0.648	0.072	14
	D3	Project Location Type	0.693	0.648	0.045	26
	D4	Right-of-Way and Utility Scope	0.813	0.833	– 0.020	36
	D5	Status of Schematic Design	0.680	0.611	0.069	18
	D6	Status of Boundary Surveying	0.693	0.722	– 0.029	29
	D7	Status of Environmental Clearance	0.920	0.852	0.068	19
	D8	Status of Right-of-Way Map	0.853	0.870	– 0.017	37
	D9	Internal R/W Staff Size of a District	0.667	0.722	– 0.055	24
	D10	District R/W Annual Budget	0.667	0.796	– 0.129	4
	D11	Dedication of Funds to the Project (R/W and Construction)	0.813	0.741	0.072	14
	D12	LPA Funded or Non-LPA Funded	0.747	0.574	0.173	2
	D13	Federally Funded or Non-Federally Funded	0.693	0.611	0.082	10
	D14	Funding Limitations for the Project	0.800	0.741	0.059	21
	D15	Level of Acceptance of the Project by the Public	0.693	0.722	– 0.029	29
	D16	Level of Political Pressure	0.667	0.593	0.074	12
	D17	Common Concerns of Property Owners	0.720	0.741	– 0.021	35
	D18	Current Status of the R/W Project	0.760	0.833	– 0.073	13
R/W Acquisition	D19	Number of Parcels for Acquisition	0.827	0.870	– 0.043	27
	D20	Different Types of Parcel Usages	0.693	0.722	– 0.029	29
	D21	Frequency of Eminent Domain	0.853	0.870	– 0.017	37
	D22	Source of Personnel to be used for R/W Acquisition	0.720	0.648	0.072	14
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.733	0.685	0.048	25
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.747	0.630	0.117	5
	D25	Type of Property Owners	0.640	0.648	– 0.008	41
	D26	Level of Familiarity with Key Landowners	0.613	0.574	0.039	28
	D27	Are There Any Property Tenants to Consider?	0.733	0.741	– 0.008	41
	D28	Need for Residential Relocation	0.880	0.722	0.158	3
	D29	Level of Local Availability of Replacement Housing Facilities	0.840	0.648	0.192	1
	D30	Need for Business Relocation	0.787	0.722	0.065	20
	D31	Level of Local Availability of Replacement Business Facilities	0.813	0.741	0.072	14
	D32	Likelihood of Title Curative Actions	0.787	0.796	– 0.009	40
	D33	Responsiveness of Local Title Companies to TxDOT	0.800	0.704	0.096	8
Utility Adjustment	D34	Have SUE Investigations Been Performed	0.653	0.630	0.023	32
	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.693	0.593	0.100	7
	D36	Utility Type	0.800	0.815	– 0.015	39
	D37	Number of Utilities Located in Public R/W	0.853	0.796	0.057	23
	D38	Number of Utilities Located in Private Easement	0.867	0.889	– 0.022	34
	D39	Number of Utilities for Adjustments or Relocations	0.893	0.815	0.078	11
	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.733	0.648	0.085	9
	D41	Responsiveness of Utility Companies to TxDOT Needs	0.893	0.870	0.023	32
	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.800	0.741	0.059	21

The final independent variable used in the analysis of the relationship between practitioners' backgrounds and the importance of the assessments of drivers was "Types of District." These district types were divided into two groups based on whether they were Rural or Urban/Metropolitan. Because of a lack of participation from Metropolitan districts, Urban districts and Metropolitan districts were combined into one category.

Table 7.14 describes the results of the PRE-application importance assessments. The practitioners from "Rural" districts evaluated 20 out of 42 duration drivers as having relatively high importance compared to the practitioners from "Urban" and "Metropolitan" districts. In contrast, 22 drivers were considered to have relatively high importance by the practitioners from Urban and Metropolitan districts. However, there were not significant differences (> 0.2) between these two groups in assessing the PRE-application importance of drivers.

Table 7.14: PRE-Application Importance of Drivers: Rural vs. Urban/Metropolitan Districts

Category	Driver	Description	PRE-Application Rural (n=28)	PRE-Application Urban/ Metro (n=15)	Difference (R-U/M)	Rank
Project Basic Facts	D1	TxDOT Project Type	0.750	0.800	– 0.050	24
	D2	TxDOT Highway Type	0.679	0.711	– 0.032	32
	D3	Project Location Type	0.702	0.622	0.080	16
	D4	Right-of-Way and Utility Scope	0.845	0.778	0.067	21
	D5	Status of Schematic Design	0.667	0.622	0.045	26
	D6	Status of Boundary Surveying	0.726	0.667	0.059	23
	D7	Status of Environmental Clearance	0.833	1.000	– 0.167	1
	D8	Status of Right-of-Way Map	0.833	0.911	– 0.078	18
	D9	Internal R/W Staff Size of a District	0.679	0.711	– 0.032	32
	D10	District R/W Annual Budget	0.726	0.711	0.015	37
	D11	Dedication of Funds to the Project (R/W and Construction)	0.738	0.867	– 0.129	3
	D12	LPA Funded or Non-LPA Funded	0.643	0.733	– 0.090	13
	D13	Federally Funded or Non-Federally Funded	0.619	0.733	– 0.114	6
	D14	Funding Limitations for the Project	0.738	0.844	– 0.106	8
	D15	Level of Acceptance of the Project by the Public	0.690	0.733	– 0.043	28
	D16	Level of Political Pressure	0.619	0.667	– 0.048	25
	D17	Common Concerns of Property Owners	0.702	0.778	– 0.076	19
	D18	Current Status of the R/W Project	0.786	0.800	– 0.014	38
R/W Acquisition	D19	Number of Parcels for Acquisition	0.845	0.844	0.001	42
	D20	Different Types of Parcel Usages	0.738	0.644	0.094	11
	D21	Frequency of Eminent Domain	0.845	0.889	– 0.044	27
	D22	Source of Personnel to be used for R/W Acquisition	0.726	0.622	0.104	9
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.738	0.667	0.071	20
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.702	0.689	0.013	39
	D25	Type of Property Owners	0.631	0.667	– 0.036	30
	D26	Level of Familiarity with Key Landowners	0.619	0.556	0.063	22
	D27	Are There Any Property Tenants to Consider?	0.726	0.756	– 0.030	34
	D28	Need for Residential Relocation	0.810	0.822	– 0.012	40
	D29	Level of Local Availability of Replacement Housing Facilities	0.762	0.756	0.006	41
	D30	Need for Business Relocation	0.798	0.689	0.109	7
	D31	Level of Local Availability of Replacement Business Facilities	0.798	0.756	0.042	29
	D32	Likelihood of Title Curative Actions	0.762	0.844	– 0.082	15
	D33	Responsiveness of Local Title Companies to TxDOT	0.726	0.822	– 0.096	10
Utility Adjustment	D34	Have SUE Investigations Been Performed	0.655	0.622	0.033	31
	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.619	0.711	– 0.092	12
	D36	Utility Type	0.798	0.822	– 0.024	36
	D37	Number of Utilities Located in Public R/W	0.857	0.778	0.079	17
	D38	Number of Utilities Located in Private Easement	0.905	0.822	0.083	14
	D39	Number of Utilities for Adjustments or Relocations	0.905	0.778	0.127	4
	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.655	0.778	– 0.123	5
	D41	Responsiveness of Utility Companies to TxDOT Needs	0.893	0.867	0.026	35
	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.833	0.667	0.166	2

7.4.1.3 Associations: PRE-Application Importance and Practitioners' Backgrounds

This section describes any important associations among the PRE-application importance assessments of duration drivers and practitioners' backgrounds, which were used as independent variables in the comparative analysis previously described.

The first analysis was to test a null hypothesis of the independence of years of experience and assessment of driver importance. As mentioned earlier, there were two types of categories for years of experience, Most and Least Experienced. In addition, there were four levels of importance from which respondents could choose: (1) High; (2) Moderate; (3) Low, and; (4) Not important. Due to a lack of samples, a chi-square test was not suitable enough for the analysis because the expected count is less than 5 in the contingency table. In order to overcome this limitation, a Fisher exact test, which is an alternative to the chi-square test, was applied. SPSS includes this alternative as one of the functions that users can choose in conducting a chi-square test.

As Table 7.15 demonstrates, there are five drivers (#10, #29, #30, #31, and #42) with small *p*-values, and these are statistically significant. One of the five drivers belongs to the category of Project Basic Facts-related, three are part of R/W Acquisition, and the remaining one is a Utility Adjustment-related driver. The obtained significant *p*-values indicate that these drivers are strongly associated with the years of experience variable. Specifically, drivers #30 (Need for Business Relocation) and #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility) were identified as having statistically significant relationships with years of experience, although they did not present large differences in the comparative analysis discussed in the previous section.

Table 7.15: Chi-square Test Results: Relationships among PRE-Application Importance and Years of Experience

Category	Driver	Fisher Exact Test (Sig. *p*)
B	District R/W Annual Budget (D10)	0.010
R	Level of Local Availability of Replacement Housing Facilities (D29)	0.053
R	Need for Business Relocation (D30)	0.023
R	Level of Local Availability of Replacement Business Facilities (D31)	0.016
U	Adjustment is Reimbursable Utility or Non-Reimbursable Utility (D42)	0.056

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

For relationships among the PRE-application importance and areas of expertise, only two duration drivers #29 (Level of Local Availability of Replacement Housing Facilities) and #36 (Utility Type) were identified as having statistically significant relationships with areas of expertise, as depicted in Table 7.16. Driver #29 is the top-ranked driver with a large difference (> 0.2) in the earlier descriptive comparison. However, driver #36 was not a duration driver evaluated as having a large difference (> 0.2) between R/W and Utility practitioners in the previous comparative analysis.

Table 7.16: Chi-square Test Results: Relationships among PRE-Application Importance and Areas of Expertise

Category	Driver	Fisher Exact Test (Sig. *p*)
R	Level of Local Availability of Replacement Housing Facilities (D29)	0.058
U	Utility Type (D36)	0.070

* B: Project Basic Facts-related, R: R/W Acquisition-related, and Utility Adjustment-related

For relationships among the PRE-application importance of drivers and types of district, five duration drivers (#5, #7, #13, #37, and #40) with significant *p*-values were identified, as described in Table 7.17. Although drivers #5 (Status of Schematic Design) and #37 (Number of Utilities Located in Public R/W) did not show large differences (> 0.2) in the previous comparative analysis using a descriptive statistic, there existed statistically significant associations between the importance of these two drivers and types of district.

Table 7.17: Chi-square Test Results: Relationships among PRE-Application Importance and Types of District

Category	Driver	Fisher Exact Test (Sig. *p*)
B	Status of Schematic Design (D5)	0.040
B	Status of Environmental Clearance (D7)	0.010
B	Federally Funded or Non-Federally Funded (D13)	0.040
U	Number of Utilities Located in Public R/W (D37)	0.050
U	Is there any Utility Adjustment to be included in the Highway Construction Contract ? (D40)	0.019

* B: Project Basic Facts-related, R: R/W Acquisition-related, and Utility Adjustment-related

Through analyzing the drivers illustrated in Tables 7.15, 7.16, and 7.17, it was found that there are statistically significant associations between practitioners' perceptions of the PRE-application importance and their backgrounds such as years of experience, types of district, and areas of expertise. In other words, it appears prudent to conclude that the various backgrounds of experts could cause significant variation in assessing the PRE-application importance of drivers, although employing the results of this analysis needs to be limited due to a lack of sample data.

7.4.2 POST-Application Importance of Duration Drivers

Along with the assessments of the PRE-application importance of drivers, the POST-application importance of drivers was also evaluated in this study. The following sections present the results of the POST-application importance assessments that were based on a 2-point scale using "not important" and "important." As mentioned in Chapter 6, the purpose of assessing the POST-application importance of driver was to identify whether drivers were really considered to be important in predicting the durations of R/W acquisition and utility adjustment processes. This assessment was conducted after the RUDI-based duration estimation had been completed. Therefore, respondents had specific information (i.e., drivers' values) about the drivers to consider when evaluating the importance of each duration driver. This extension in the specificity of information respondents could consider the main way that POST-application importance assessment differed from that of the PRE-application importance assessment. However, employing the results of this analysis should be limited because only project B was analyzed in this study.

7.4.2.1 All Respondents

As depicted in Table 7.18, driver #4 (R/W and Utility Scope) and driver #18 (Current Status of the Right-of-Way Project) ranked in the top ten of POST-application importance, and these were related to the Project Basic Facts. Among the R/W Acquisition-related drivers, the POST-application drivers ranked as highly important are as follows:

- Number of Parcels for Acquisition (D19)
- Frequency of Eminent Domain (D21)
- Need for Residential Relocation (D28)
- Level of Local Availability of Replacement Housing Facilities (D29)
- Need for Business Relocation (D30)

Among Utility Adjustment-related duration drivers, the following POST-application drivers ranked in the top ten:

- Utility Type (D36)

- Number of Utilities Located in Public R/W (D37)
- Number of Utilities Located in Private Easement (D38)
- Responsiveness of Utility Companies to TxDOT Needs (D41)

However, some of these drivers were ranked significant differently in the PRE-application importance assessments as described in Table 7.11. Specifically, drivers #30 (Need for Business Relocation) and #29 (Level of Local Availability of Replacement Housing Facilities) were ranked 19th, respectively, in the PRE-application importance assessments. In contrast, the remaining eight drivers were evaluated as having relatively high PRE-application importance and their ranking scores were between 1st and 12th even though they were slightly different. This evaluation pattern was found in the top ten drivers identified from the PRE-application importance assessments. Except for drivers #1 (TxDOT Project Type), #8 (Status of Right-of-Way Map), and #39 (Number of Utilities for Adjustment or Relocations), the remaining seven drivers were ranked in the top ten in the POST-application importance assessments even though there were slight changes in their rankings. However, drivers #1, #8, and #39 showed significant differences in rankings of their POST-application importance. In particular, driver #1 was ranked in 35th place even though that driver was the most important one in the PRE-application importance assessments. These differences found in assessing the importance of drivers emphasized that shifts between PRE-application and POST-application importance assessments should be analyzed in more detail using effective analysis methods.

Table 7.18: Descriptive Statistics of POST-Application Importance Assessments

Category	Driver	Description	Mean (n=43)	Rank
Project Basic Facts	D1	TxDOT Project Type	0.465	35
	D2	TxDOT Highway Type	0.442	38
	D3	Project Location Type	0.698	12
	D4	Right-of-Way and Utility Scope	0.860	3
	D5	Status of Schematic Design	0.488	32
	D6	Status of Boundary Surveying	0.535	25
	D7	Status of Environmental Clearance	0.674	15
	D8	Status of Right-of-Way Map	0.674	16
	D9	Internal R/W Staff Size of a District	0.535	23
	D10	District R/W Annual Budget	0.535	24
	D11	Dedication of Funds to the Project (R/W and Construction)	0.651	17
	D12	LPA Funded or Non-LPA Funded	0.465	35
	D13	Federally Funded or Non-Federally Funded	0.372	40
	D14	Funding Limitations for the Project	0.488	31
	D15	Level of Acceptance of the Project by the Public	0.372	39
	D16	Level of Political Pressure	0.302	41
	D17	Common Concerns of Property Owners	0.442	37
	D18	Current Status of the R/W Project	0.744	7
R/W Acquisition	D19	Number of Parcels for Acquisition	0.907	1
	D20	Different Types of Parcel Usages	0.535	25
	D21	Frequency of Eminent Domain	0.721	10
	D22	Source of Personnel to be used for R/W Acquisition	0.465	34
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.488	33
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.651	17
	D25	Type of Property Owners	0.512	27
	D26	Level of Familiarity with Key Landowners	0.512	28
	D27	Are There Any Property Tenants to Consider?	0.512	30
	D28	Need for Residential Relocation	0.744	7
	D29	Level of Local Availability of Replacement Housing Facilities	0.791	6
	D30	Need for Business Relocation	0.791	5
	D31	Level of Local Availability of Replacement Business Facilities	0.605	22
	D32	Likelihood of Title Curative Actions	0.698	12
	D33	Responsiveness of Local Title Companies to TxDOT	0.651	17
Utility Adjustment	D34	Have SUE Investigations Been Performed	0.605	21
	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.465	36
	D36	Utility Type	0.721	10
	D37	Number of Utilities Located in Public R/W	0.744	9
	D38	Number of Utilities Located in Private Easement	0.814	4
	D39	Number of Utilities for Adjustments or Relocations	0.628	20
	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.512	28
	D41	Responsiveness of Utility Companies to TxDOT Needs	0.884	2
	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.698	12

7.4.2.2 Analysis Using Practitioners' Backgrounds

Similar to the analysis of the PRE-application importance of duration drivers, the assessments of the POST-application driver importance were also analyzed using practitioners' backgrounds: years of experience, areas of expertise, and types of district.

The first analysis of the POST-application importance of duration drivers was based on years of experience. As illustrated in Table 7.19, 19 out of 42 drivers were evaluated as having relatively high importance by the Least Experienced practitioners as compared to the Most Experienced practitioners. Conversely, the Most Experienced practitioners considered the remaining 23 drivers as having much higher importance as compared to the Least Experienced practitioners. Moreover, there are seven duration drivers with large differences in importance assessments, and these differences exceed the cut-off (> 0.2) point. One of the possible causes for these large differences could be the values of the duration drivers. The impact of driver values on the perception of the duration driver importance was investigated using a McNemar's test in the later sections of this chapter. The POST-application drivers with large differences with more than 0.2 are as follows:

- Status of Boundary Surveying (D6)
- Federally Funded or Non-Federally Funded (D13)
- Current Status of the R/W Project (D18)
- Availability of District R/W Appraisers (District Staff and Outsourced) (D23)
- Level of Local Availability of Replacement Business Facilities (D31)
- Likelihood of Title Curative Actions (D32)
- Responsiveness of Local Title Companies to TxDOT (D33)

Table 7.19: POST-Application Importance of Drivers: Most vs. Least Experienced Practitioners

Cate.	Driver	Description	POST-Application		Difference (M-L)	Rank	Model Project Value
			Most Experienced (n=22)	Least Experienced (n=21)			
Project Basic Facts	D1	TxDOT Project Type	0.409	0.524	– 0.115		
	D2	TxDOT Highway Type	0.409	0.476	– 0.067		
	D3	Project Location Type	0.773	0.619	0.154		
	D4	Right-of-Way and Utility Scope	0.818	0.905	– 0.087		
	D5	Status of Schematic Design	0.500	0.476	0.024		
	D6	Status of Boundary Surveying	0.636	0.429	0.208	6	Completed
	D7	Status of Environmental Clearance	0.682	0.667	0.015		
	D8	Status of Right-of-Way Map	0.636	0.714	– 0.078		
	D9	Internal R/W Staff Size of a District	0.591	0.476	0.115		
	D10	District R/W Annual Budget	0.591	0.476	0.115		
	D11	Dedication of Funds to the Project (R/W and Construction)	0.682	0.619	0.063		
	D12	LPA Funded or Non-LPA Funded	0.455	0.476	– 0.022		
	D13	Federally Funded or Non-Federally Funded	0.273	0.476	– 0.203	7	Federally
	D14	Funding Limitations for the Project	0.409	0.571	– 0.162		
	D15	Level of Acceptance of the Project by the Public	0.318	0.429	– 0.110		
	D16	Level of Political Pressure	0.318	0.286	0.032		
	D17	Common Concerns of Property Owners	0.409	0.476	– 0.067		
	D18	Current Status of the R/W Project	0.636	0.857	– 0.221	4	Full release
R/W Acquisition	D19	Number of Parcels for Acquisition	0.955	0.857	0.097		
	D20	Different Types of Parcel Usages	0.545	0.524	0.022		
	D21	Frequency of Eminent Domain	0.773	0.667	0.106		
	D22	Source of Personnel to be used for R/W Acquisition	0.545	0.381	0.165		
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.591	0.381	0.210	5	Marginally adequate
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.636	0.667	– 0.030		
	D25	Type of Property Owners	0.500	0.524	– 0.024		
	D26	Level of Familiarity with Key Landowners	0.500	0.524	– 0.024		
	D27	Are There Any Property Tenants to Consider?	0.545	0.476	0.069		
	D28	Need for Residential Relocation	0.727	0.762	– 0.035		
	D29	Level of Local Availability of Replacement Housing Facilities	0.773	0.810	– 0.037		
	D30	Need for Business Relocation	0.727	0.857	– 0.130		
	D31	Level of Local Availability of Replacement Business Facilities	0.773	0.429	0.344	1	Low
	D32	Likelihood of Title Curative Actions	0.818	0.571	0.247	3	High
	D33	Responsiveness of Local Title Companies to TxDOT	0.773	0.524	0.249	2	High
Utility Adjustment	D34	Have SUE Investigations Been Performed	0.545	0.667	– 0.121		
	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.455	0.476	– 0.022		
	D36	Utility Type	0.727	0.714	0.013		
	D37	Number of Utilities Located in Public R/W	0.773	0.714	0.058		
	D38	Number of Utilities Located in Private Easement	0.864	0.762	0.102		
	D39	Number of Utilities for Adjustments or Relocations	0.682	0.571	0.110		
	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.455	0.571	– 0.117		
	D41	Responsiveness of Utility Companies to TxDOT Needs	0.909	0.857	0.052		
	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.727	0.667	0.061		

Table 7.20 depicts the results of the analysis undertaken on the basis of areas of expertise. One of the observations from this analysis is that drivers with large discrepancy (> 0.2) are different from drivers with those same levels of differences in the previous comparative analysis using years of experience. This finding suggests that the backgrounds of respondents can be considered factors causing perceptual differences in assessing the importance of the drivers.

Even though drivers did not show large differences in the PRE-application importance assessments, eight drivers in the assessments of the POST-application importance showed differences that were more than the cut-off point (> 0.2). R/W practitioners considered these drivers as having relatively high importance more often than Utility practitioners did when R/W practitioners knew specific information about the drivers. These drivers include: #1 (TxDOT Project Type), #3 (Project Location Type), #5 (Status of Schematic Design), #31 (Level of Local Availability of Replacement Business Facilities), #33 (Responsiveness of Local Title Companies to TxDOT), #35 (Will SUE Investigations be performed?), #37 (Number of Utilities Located in Public R/W), and #39 (Number of Utilities for Adjustments or Relocations).

In addition, eight drivers were evaluated as having more significance by Utility practitioners than R/W ones. These drivers are: #4 (Right-of-Way and Utility Scope), #9 (Internal R/W Staff Size of a District), #10 (District R/W Annual Budget), #20 (Different Types of Parcel Usages), #30 (Need for Business Relocation), #36 (Utility Type), #38 (Number of Utilities Located in Private Easement), and #41 (Responsiveness of Utility Companies to TxDOT Needs).

Table 7.20: POST-Application Importance of Drivers: R/W Experts vs. Utility Practitioners

Cate.	Driver	Description	POST-Application R/W Expert (n=25)	POST-Application Utility Expert (n=18)	Difference (R-U)	Rank	Model Project Value
Project Basic Facts	D1	TxDOT Project Type	0.560	0.333	0.227	6	RER
	D2	TxDOT Highway Type	0.480	0.389	0.091		
	D3	Project Location Type	0.800	0.556	0.244	4	Rural
	D4	Right-of-Way and Utility Scope	0.800	0.944	– 0.144		
	D5	Status of Schematic Design	0.600	0.333	0.267	2	Completed
	D6	Status of Boundary Surveying	0.600	0.444	0.156		
	D7	Status of Environmental Clearance	0.680	0.667	0.013		
	D8	Status of Right-of-Way Map	0.680	0.667	0.013		
	D9	Internal R/W Staff Size of a District	0.520	0.556	– 0.036		
	D10	District R/W Annual Budget	0.520	0.556	– 0.036		
	D11	Dedication of Funds to the Project (R/W and Construction)	0.720	0.556	0.164		
	D12	LPA Funded or Non-LPA Funded	0.480	0.444	0.036		
	D13	Federally Funded or Non-Federally Funded	0.400	0.333	0.067		
	D14	Funding Limitations for the Project	0.560	0.389	0.171		
	D15	Level of Acceptance of the Project by the Public	0.400	0.333	0.067		
	D16	Level of Political Pressure	0.360	0.222	0.138		
	D17	Common Concerns of Property Owners	0.480	0.389	0.091		
	D18	Current Status of the R/W Project	0.760	0.722	0.038		
R/W Acquisition	D19	Number of Parcels for Acquisition	0.920	0.889	0.031		
	D20	Different Types of Parcel Usages	0.520	0.556	– 0.036		
	D21	Frequency of Eminent Domain	0.800	0.611	0.189		
	D22	Source of Personnel to be used for R/W Acquisition	0.480	0.444	0.036		
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.520	0.444	0.076		
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.680	0.611	0.069		
	D25	Type of Property Owners	0.520	0.500	0.020		
	D26	Level of Familiarity with Key Landowners	0.520	0.500	0.020		
	D27	Are There Any Property Tenants to Consider?	0.560	0.444	0.116		
	D28	Need for Residential Relocation	0.760	0.722	0.038		
	D29	Level of Local Availability of Replacement Housing Facilities	0.800	0.778	0.022		
	D30	Need for Business Relocation	0.760	0.833	– 0.073		
	D31	Level of Local Availability of Replacement Business Facilities	0.720	0.444	0.276	1	Low
	D32	Likelihood of Title Curative Actions	0.760	0.611	0.149		
	D33	Responsiveness of Local Title Companies to TxDOT	0.760	0.500	0.260	3	High
Utility Adjustment	D34	Have SUE Investigations Been Performed	0.640	0.556	0.084		
	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.560	0.333	0.227	6	Yes
	D36	Utility Type	0.720	0.722	– 0.002		
	D37	Number of Utilities Located in Public R/W	0.840	0.611	0.229	5	4 to 7
	D38	Number of Utilities Located in Private Easement	0.800	0.833	– 0.033		
	D39	Number of Utilities for Adjustments or Relocations	0.720	0.500	0.220	8	More than 7
	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.520	0.500	0.020		
	D41	Responsiveness of Utility Companies to TxDOT Needs	0.840	0.944	– 0.104		
	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.720	0.667	0.053		

The third independent variable used in analyzing any important relationships between practitioners' backgrounds and the POST-application importance was "Types of District." Table 7.21 describes the results of these POST-application importance assessments. The experts from Rural Districts evaluated 30 out of 42 duration drivers as having relatively high importance compared to the practitioners from Urban / Metropolitan Districts. In contrast, 12 drivers were considered to have relatively high importance by the practitioners from Urban / Metropolitan Districts. Moreover, there were significant differences (> 0.2) between these two groups in assessing the POST-application importance of drivers. These drivers include:

- Level of Political Pressure (D16)
- Common Concerns of Property Owners (D17)
- Frequency of Eminent Domain (D21)
- Source of Personnel to be used for R/W Acquisition (D22)
- Are There Any Property Tenants to Consider? (D27)
- Responsiveness of Local Title Companies to TxDOT (D33)
- Will SUE Investigations be performed? (D35)
- Number of Utilities for Adjustments or Relocations (D39)
- Adjustment is Reimbursable Utility or Non-Reimbursable Utility (D42)

One of the findings from this analysis is that the differences of these drivers may have been influenced by the driver values for project B. This speculation was retested using a McNemar's test in section 7.6.

Table 7.21: POST-Application Importance of Drivers: Rural vs. Urban/Metropolitan District

Cate.	Driver	Description	POST-Application Rural (n=28)	POST-Application Urban/ Metro (n=15)	Difference (R-U/M)	Rank	Model Project Value
Project Basic Facts	D1	TxDOT Project Type	0.429	0.533	– 0.104		
	D2	TxDOT Highway Type	0.393	0.533	– 0.140		
	D3	Project Location Type	0.750	0.600	0.150		
	D4	Right-of-Way and Utility Scope	0.857	0.867	– 0.010		
	D5	Status of Schematic Design	0.500	0.467	0.033		
	D6	Status of Boundary Surveying	0.571	0.467	0.104		
	D7	Status of Environmental Clearance	0.714	0.600	0.114		
	D8	Status of Right-of-Way Map	0.679	0.667	0.012		
	D9	Internal R/W Staff Size of a District	0.536	0.533	0.003		
	D10	District R/W Annual Budget	0.536	0.533	0.003		
	D11	Dedication of Funds to the Project (R/W and Construction)	0.679	0.600	0.079		
	D12	LPA Funded or Non-LPA Funded	0.464	0.467	– 0.003		
	D13	Federally Funded or Non-Federally Funded	0.321	0.467	– 0.146		
	D14	Funding Limitations for the Project	0.429	0.600	– 0.171		
	D15	Level of Acceptance of the Project by the Public	0.393	0.333	0.060		
	D16	Level of Political Pressure	0.393	0.133	0.260	6	Moderate
	D17	Common Concerns of Property Owners	0.571	0.200	0.371	2	Access
	D18	Current Status of the R/W Project	0.750	0.733	0.017		
R/W Acquisition	D19	Number of Parcels for Acquisition	0.929	0.867	0.062		
	D20	Different Types of Parcel Usages	0.536	0.533	0.003		
	D21	Frequency of Eminent Domain	0.643	0.867	– 0.224	8	Several
	D22	Source of Personnel to be used for R/W Acquisition	0.536	0.333	0.203	9	District staff
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.500	0.467	0.033		
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.679	0.600	0.079		
	D25	Type of Property Owners	0.536	0.467	0.069		
	D26	Level of Familiarity with Key Landowners	0.500	0.533	– 0.033		
	D27	Are There Any Property Tenants to Consider?	0.607	0.333	0.274	5	No
	D28	Need for Residential Relocation	0.786	0.667	0.119		
	D29	Level of Local Availability of Replacement Housing Facilities	0.821	0.733	0.088		
	D30	Need for Business Relocation	0.786	0.800	– 0.014		
	D31	Level of Local Availability of Replacement Business Facilities	0.643	0.533	0.110		
	D32	Likelihood of Title Curative Actions	0.750	0.600	0.150		
	D33	Responsiveness of Local Title Companies to TxDOT	0.750	0.467	0.283	4	High
Utility Adjustment	D34	Have SUE Investigations been Performed	0.607	0.600	0.007		
	D35	Will SUE Investigations be performed? (If no or unknown in the duration driver # 34)	0.357	0.667	– 0.310	3	Yes
	D36	Utility Type	0.714	0.733	– 0.019		
	D37	Number of Utilities Located in Public R/W	0.714	0.800	– 0.086		
	D38	Number of Utilities Located in Private Easement	0.821	0.800	0.021		
	D39	Number of Utilities for Adjustments or Relocations	0.786	0.333	0.453	1	More than 7
	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.536	0.467	0.069		
	D41	Responsiveness of Utility Companies to TxDOT Needs	0.893	0.867	0.026		
	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.786	0.533	0.253	7	Reimbursable/ Non-reimbursable

7.4.2.3 Associations: POST-Application Importance and Practitioners' Backgrounds

This section describes the results of the chi-square test, which was used to analyze any important associations among practitioners' backgrounds and the POST-application importance of drivers. The comparative analyses described in the previous section produced some drivers with large differences (> 0.2) according to the respondents' backgrounds. However, these differences were not tested using an approach capable of indicating statistical significance.

A chi-square test that is useful in determining whether two groups differ was applied to examine associations among the POST-application importance and practitioners' backgrounds. First, in analyzing the relationships between years of experience and POST-application importance, only driver #31 (Level of Local Availability of Replacement Business Facilities) was identified as having a statistically significant *p*-value (0.03), meaning that there is perceptual difference between practitioners with more than 13 years experience and ones with less than 13 years in perceiving the importance of this driver.

Table 7.22 illustrates the results of the analysis of relationships among the POST-application importance of drivers and areas of expertise. There are two drivers related to the categories of Project Basic Facts and R/W Acquisition, respectively that have such POST-application importance. Although the *p*-values of the identified drivers were relatively high when compared to the p-values ($p < 0.05$) used in the previous comparative studies, these drivers could be considered practically important. These drivers' test statistics are small enough to have practical significance to the practitioners even though they are not statistically significant.

Table 7.22: Chi-square Test Results: Relationships among POST-Application Importance and Areas of Expertise

Category	Driver	Fisher Exact Test (Sig. *p*)
B	Project Location Type (D3)	0.100
B	Status of Schematic Design (D5)	0.124
R	Level of Local Availability of Replacement Business Facilities (D31)	0.114
R	Responsiveness of Local Title Companies to TxDOT (D33)	0.109

* B: Project Basic Facts-related, R: R/W Acquisition-related, and Utility Adjustment-related

The analysis on the basis of types of district revealed six duration drivers (#16, #17, #27, #33, #35, and #39) that were ranked differently in terms of importance to a significant degree, and these are described in Table 7.23. All of the identified drivers were included in the list of drivers with large differences exceeding the cut-off point (> 0.2) in the previous comparative analysis. This observation means that there were significant differences between practitioners from districts located in various areas in TxDOT. However, drivers #21 (Frequency of Eminent Domain), #22 (Source of Personnel to be used for R/W Acquisition), and #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility) were not identified as drivers with statistical significance even though they were ranked in the top ten of drivers in Table 7.21.

Table 7.23 Chi-square Test Results: Relationships among POST-Application Importance and Types of District

Category	Driver	Fisher Exact Test (Sig. *p*)
B	Level of Political Pressure (D16)	0.096
B	Common Concerns of Property Owners (D17)	0.026
R	Are There any Property Tenants to Consider? (D27)	0.116
R	Responsiveness of Local Title Companies to TxDOT (D33)	0.095
U	Will SUE Investigations be performed? (D35)	0.064
U	Number of Utilities for Adjustments or Relocations (D39)	0.007

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

7.5 ASSOCIATIONS WITH DURATION ESTIMATION ACCURACY

This section consists of three parts. The first part describes the findings of the study of associations among the accuracy of non-RUDI-based duration estimations and practitioners' backgrounds using a chi-square test. The second and third sections illustrate the results of the analysis of the driver importance on the basis of the accuracy of the respondents' non-RUDI-based duration estimations that were based on their personal judgments.

7.5.1 Associations: Practitioners' Backgrounds and Duration Estimation Accuracy

7.5.1.1 Associations: Practitioners' Backgrounds and Accuracy of R/W Acquisition Duration Estimation

As mentioned earlier, practitioners with more than 13 years were defined as "Most Experienced," and those with less than 13 years were defined as "Least Experienced." Through this analysis, it was possible to identify the strength of the association between years of experience and the accuracy of non-RUDI-based duration estimation.

As presented in Table 7.24, the chi-square test produced a significant *p*-value (0.018). This small significant value means that there is a significant relationship between the two factors. It also means that the research hypothesis that "Years of Experience" may have played an important role in producing differences in the R/W duration estimation accuracy proved to be true. Practitioners with less than 13 years of experience can exhibit less accuracy in determining the durations of R/W acquisition than practitioners with more than 13 years of experience.

Table 7.24: Chi-square Test Results: Years of Experience and Accuracy of R/W Duration

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.571(b)	1	.018	.047	.024	
Continuity Correction(a)	3.869	1	.049			
Likelihood Ratio	5.796	1	.016	.047	.024	
Fisher's Exact Test				.047	.024	
Linear-by-Linear Association	5.357(c)	1	.021	.047	.024	.021
N of Valid Cases	26					

Like the chi-square test for years of experience, the chi-square test for analyzing the relationship between Areas of Expertise and the accuracy of duration estimation for the R/W acquisition process also provided a significant *p*-value (0.006). Therefore, it can be said that an expert's "Areas of Expertise" has a strong association with the accuracy of his or her non-RUDI-based duration estimations for R/W acquisition. As depicted in Table 7.25, R/W experts were more accurate than Utility practitioners in determining the durations of R/W acquisition.

Table 7.25: Chi-square Test Results: Areas of Experience and Accuracy of R/W Duration

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	7.462(b)	1	.006	.016	.009	
Continuity Correction(a)	5.462	1	.019			
Likelihood Ratio	7.845	1	.005	.016	.009	
Fisher's Exact Test				.016	.009	
Linear-by-Linear Association	7.175(c)	1	.007	.016	.009	.008
N of Valid Cases	26					

The final factor to test using the chi-square test was “Types of District.” As mentioned earlier, district types were divided into two groups: Rural and Urban/Metropolitan due to the lack of sample data from Metropolitan districts. As Table 7.26 shows, the *p*-value provided by the chi-square test is not statistically significant (0.555), and this insignificance means that there is a weak relationship between Types of District and the accuracy of non-RUDI-based duration estimations of the R/W acquisition process. The weak association was also apparent when descriptively comparing districts of More Accurate and Less Accurate estimators. While nine out of the 14 More Accurate estimators were practitioners working in Rural Districts, nine out of the 12 Less Accurate estimators were also from districts in rural areas as described in Table 7.27.

Table 7.26: Chi-square Test Results: Types of District and Accuracy of R/W Duration

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.348(b)	1	.555	.683	.437	
Continuity Correction(a)	.027	1	.870			
Likelihood Ratio	.351	1	.553	.683	.437	
Fisher's Exact Test				.683	.437	
Linear-by-Linear Association	.335(c)	1	.563	.683	.437	.282
N of Valid Cases	26					

Table 7.27 illustrates the three-dimensional relationships among practitioners' backgrounds and the accuracy of non-RUDI-based R/W acquisition duration estimation. Three out of the nine More Accurate estimators from Rural Districts have less than 13 years of experience, which was a cut-off point in this study, while the years of experience of the remaining six estimators are more than 13 years. Even though this finding was

based on a small sample, it appears to be prevalent that practitioners with more than 13 years of experience from Rural Districts have an improved ability to accurately predict durations for R/W acquisition as compared to Least Experienced practitioners (less than 13 years of experience) from Rural Districts. In contrast, among the five More Accurate estimators from Urban / Metropolitan Districts, four are Most Experienced practitioners with more than 13 years of experience. Based on these results, it may be assumed that Years of Experience may have strong associations with the accuracy of R/W acquisition duration estimation. However, this speculation was not consistently true for Less Accurate estimators as described in Table 7.27. Therefore, it is necessary to examine additional sample data in order to improve the reliability of the result.

Table 7.27: Associations among Backgrounds of Practitioners and Accuracy Non-RUDI-based R/W Duration

Estr	Practitioners' Backgrounds			R/W Acquisition		Accuracy of Estimation	Estr	Practitioners' Backgrounds			R/W Acquisition		Accuracy of Estimation
	Years of Experience	Areas of Expertise	Types of District	R2	R3			Years of Experience	Areas of Expertise	Types of District	R2	R3	
E#1	< 13	Utility	Rural	Less	Less	Less Accurate	E#23	> 13	R/W	Urban/Metro.	More	More	More Accurate
E#2	> 13	R/W	Rural	Moderately	Less	Moderately Accurate	E#24	< 13	Utility	Rural	Less	Less	Leas Accurate
E#3	< 13	R/W	Rural	More	More	More Accurate	E#25	< 13	R/W	Rural	Less	Moderately	Moderately Accurate
E#4	> 13	R/W	Rural	More	More	More Accurate	E#26	> 13	R/W	Rural	More	More	More Accurate
E#5	> 13	R/W	Rural	More	More	More Accurate	E#27	> 13	Utility	Rural	More	More	More Accurate
E#6	> 13	R/W	Rural	Less	More	Moderately Accurate	E#28	< 13	R/W	Rural	More	More	More Accurate
E#7	> 13	R/W	Rural	Moderately	Less	Moderately Accurate	E#29	> 13	R/W	Rural	Moderately	More	Moderately Accurate
E#8	> 13	Utility	Rural	More	More	More Accurate	E#30	> 13	R/W	Rural	Less	Less	Less Accurate
E#9	< 13	Utility	Rural	Less	Less	Less Accurate	E#31	< 13	Utility	Rural	Moderately	Less	Moderately Accurate
E#10	< 13	Utility	Rural	Less	Less	Less Accurate	E#32	< 13	Utility	Rural	Less	Less	Less Accurate
E#11	< 13	Utility	Urban/Metro.	Less	Moderately	Moderately Accurate	E#33	> 13	Utility	Rural	Less	Less	Less Accurate
E#12	> 13	R/W	Urban/Metro.	More	More	More Accurate	E#34	< 13	R/W	Rural	More	More	More Accurate
E#13	> 13	R/W	Rural	Less	Moderately	Moderately Accurate	E#35	< 13	Utility	Rural	Less	Less	Less Accurate
E#14	< 13	R/W	Urban/Metro.	Moderately	Less	Moderately Accurate	E#36	> 13	R/W	Urban/Metro.	More	Moderately	Moderately Accurate
E#15	> 13	R/W	Urban/Metro.	Less	Less	Less Accurate	E#37	< 13	Utility	Urban/Metro.	Less	Less	Less Accurate
E#16	> 13	R/W	Urban/Metro.	Moderately	More	Moderately Accurate	E#38	< 13	R/W	Rural	Less	Less	Less Accurate
E#17	< 13	Utility	Urban/Metro.	More	Moderately	Moderately Accurate	E#39	> 13	R/W	Rural	More	More	More Accurate
E#18	> 13	Utility	Urban/Metro.	More	More	More Accurate	E#40	< 13	Utility	Rural	Less	More	Moderately Accurate
E#19	< 13	Utility	Urban/Metro.	More	Moderately	Moderately Accurate	E#41	< 13	Utility	Urban/Metro.	Less	Less	Less Accurate
E#20	> 13	R/W	Urban/Metro.	More	More	More Accurate	E#42	> 13	R/W	Rural	Moderately	More	Moderately Accurate
E#21	< 13	Utility	Urban/Metro.	More	Moderately	Moderately Accurate	E#43	> 13	R/W	Rural	Moderately	Moderately	Moderately Accurate
E#22	< 13	R/W	Urban/Metro.	More	More	More Accurate							

7.5.1.2 Associations: Practitioners' Backgrounds and Accuracy of Utility Adjustment Duration Estimation

In the analysis of the relationships among years of experience and accuracy of utility adjustment duration estimations based on personal judgments, the *p*-value was not statistically significant (0.742), and the Fisher's exact test also produced a value of 1.00, as described in Table 7.28. In other words, the factor "Years of Experience" appears not to be associated with the accuracy of duration estimations for the utility adjustment process.

Table 7.28: Chi-square Test Results: Years of Experience and Accuracy of Utility Duration

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.108(b)	1	.742	1.000	.534	
Continuity Correction(a)	.000	1	1.000			
Likelihood Ratio	.109	1	.742	1.000	.534	
Fisher's Exact Test				1.000	.534	
Linear-by-Linear Association	.104(c)	1	.747	1.000	.534	.303
N of Valid Cases	25					

The *p*-value of the chi-square test for the relationship among Areas of Expertise and the accuracy of the duration estimations for utility adjustment was also not statistically significant (0.897), as described in Table 7.29. That is, the strength of the association among Areas of Expertise and the accuracy of non-RUDI-based duration of the utility adjustment was negligible.

Table 7.29: Chi-square Test Results: Areas of Expertise and Accuracy of Utility Duration

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.017(b)	1	.897	1.000	.607	
Continuity Correction(a)	.000	1	1.000			
Likelihood Ratio	.017	1	.897	1.000	.607	
Fisher's Exact Test				1.000	.607	
Linear-by-Linear Association	.016(c)	1	.899	1.000	.607	.311
N of Valid Cases	25					

Table 7.30 describes the results of the chi-square test to determine any association among Types of District and the accuracy of non-RUDI-based duration estimation for utility adjustment. The *p*-value of Fisher's exact test was statistically significant (0.042), meaning that the factor "Types of District" is strongly associated with accuracy differences in estimations of the durations of the utility adjustment process. Practitioners from Urban / Metropolitan districts were more accurate than practitioners from Rural Districts. This means that the practitioners from Rural Districts were not as accurate as practitioners from Urban / Metropolitan Districts, even though the project they needed to estimate was located in a rural area.

This relationship appeared when investigating districts of More Accurate and Less Accurate estimators in non-RUDI-based utility adjustment duration estimation. Nine out of 14 More Accurate estimators were from Urban / Metropolitan districts, while only two out of 11 Less Accurate estimators were practitioners at districts in urban or metropolitan areas as describe in Table 7.31.

Table 7.30: Chi-square Test Results: Types of District and Accuracy of Utility Duration

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.314(b)	1	.021	.042	.027	
Continuity Correction(a)	3.608	1	.058			
Likelihood Ratio	5.616	1	.018	.042	.027	
Fisher's Exact Test				.042	.027	
Linear-by-Linear Association	5.101(c)	1	.024	.042	.027	.025
N of Valid Cases	25					

The pattern shown in Table 7.27 representing the three-dimensional relationships among accuracy of durations and more than two types of practitioners' backgrounds was not found in the non-RUDI-based utility adjustment duration estimation, as indicated in Table 7.31. In other words, as identified in the chi-square test, even though there was a statistically important association among Types of District and accuracy of utility adjustment duration, having many years of experience was not a critical factor in improving the accuracy of non-RUDI-based utility adjustment duration estimation. Table 7.31 illustrates the backgrounds of practitioners and the accuracy of each practitioner in non-RUDI-based utility adjustment duration estimation.

Table 7.31: Associations among Backgrounds of Practitioners and Accuracy Non-RUDI-based Utility Duration

Estr	Practitioners' Backgrounds			Utility Adjustment		Accuracy of Estimation	Estr	Practitioners' Backgrounds			Utility Adjustment		Accuracy of Estimation
	Years of Experience	Areas of Expertise	Types of District	U1	U3			Years of Experience	Areas of Expertise	Types of District	U1	U3	
E#1	< 13	Utility	Rural	Less	Less	Less Accurate	E#23	> 13	R/W	Urban/Metro.	More	More	More Accurate
E#2	> 13	R/W	Rural	More	Less	Moderately Accurate	E#24	< 13	Utility	Rural	Less	Less	Less Accurate
E#3	< 13	R/W	Rural	More	Moderately	Moderately Accurate	E#25	< 13	R/W	Rural	More	Moderately	Moderately Accurate
E#4	> 13	R/W	Rural	Moderately	Moderately	Moderately Accurate	E#26	> 13	R/W	Rural	More	Moderately	Moderately Accurate
E#5	> 13	R/W	Rural	Less	More	Moderately Accurate	E#27	> 13	Utility	Rural	Moderately	More	Moderately Accurate
E#6	> 13	R/W	Rural	More	Less	Moderately Accurate	E#28	< 13	R/W	Rural	Less	More	Moderately Accurate
E#7	> 13	R/W	Rural	Less	Less	Less Accurate	E#29	> 13	R/W	Rural	Less	Moderately	Moderately Accurate
E#8	> 13	Utility	Rural	Moderately	Moderately	Moderately Accurate	E#30	> 13	R/W	Rural	Less	Less	Less Accurate
E#9	< 13	Utility	Rural	Less	Less	Less Accurate	E#31	< 13	Utility	Rural	Less	Less	Less Accurate
E#10	< 13	Utility	Rural	Less	Moderately	Moderately Accurate	E#32	< 13	Utility	Rural	More	More	More Accurate
E#11	< 13	Utility	Urban/Metro.	Less	Moderately	Moderately Accurate	E#33	> 13	Utility	Rural	More	More	More Accurate
E#12	> 13	R/W	Urban/Metro.	Moderately	Moderately	Moderately Accurate	E#34	< 13	R/W	Rural	More	More	More Accurate
E#13	> 13	R/W	Rural	Moderately	Less	Moderately Accurate	E#35	< 13	Utility	Rural	More	More	More Accurate
E#14	< 13	R/W	Urban/Metro.	Moderately	Less	Moderately Accurate	E#36	> 13	R/W	Urban/Metro.	More	More	More Accurate
E#15	> 13	R/W	Urban/Metro.	Less	Less	Less Accurate	E#37	< 13	Utility	Urban/Metro.	More	More	More Accurate
E#16	> 13	R/W	Urban/Metro.	More	More	More Accurate	E#38	< 13	R/W	Rural	Less	Less	Less Accurate
E#17	< 13	Utility	Urban/Metro.	More	More	More Accurate	E#39	> 13	R/W	Rural	Less	Less	Less Accurate
E#18	> 13	Utility	Urban/Metro.	More	More	More Accurate	E#40	< 13	Utility	Rural	Less	Less	Less Accurate
E#19	< 13	Utility	Urban/Metro.	More	More	More Accurate	E#41	< 13	Utility	Urban/Metro.	More	More	More Accurate
E#20	> 13	R/W	Urban/Metro.	Moderately	Less	Moderately Accurate	E#42	> 13	R/W	Rural	More	More	More Accurate
E#21	< 13	Utility	Urban/Metro.	Less	Less	Less Accurate	E#43	> 13	R/W	Rural	Moderately	Moderately	Moderately Accurate
E#22	< 13	R/W	Urban/Metro.	More	More	More Accurate							

7.5.2 Associations: PRE-Application Importance and Duration Estimation Accuracy

This section describes those drivers evaluated as the most important and critical drivers by the more accurate estimators in forecasting the durations of the R/W acquisition and utility adjustment processes. This section does so by presenting an analysis of the assessments of the PRE-application driver importance offered by estimators with different predictive accuracies.

The drivers commonly used by both More and Less Accurate estimators were removed from the final list in this study because these drivers could not present perceptual differences that exist among two groups of estimators. Moreover, the identified drivers were tested using a chi-square test. Identifying the most important drivers used by estimators with high accuracy was one of this study's objectives, which is why the chi-square test was used.

Based on the methodology of accuracy determination mentioned earlier, 14 practitioners were categorized as the Most Accurate estimators in both R/W acquisition and utility adjustment processes, respectively. In addition, 12 and 11 practitioners, respectively, were designated as Less Accurate estimators for R/W acquisition and utility adjustment duration estimations based on their personal judgments.

7.5.2.1 R/W Acquisition Durations

a. Drivers Deemed Important by More Accurate Estimators

As described in the introductory section of the dissertation, this study assumed that Project Basic Facts-related drivers have an influence on both R/W acquisition and utility adjustment. Therefore, for the R/W acquisition duration, Project Basic Facts-related drivers and R/W Acquisition-related drivers were investigated. There are 33 of these drivers.

Table 7.32 illustrates the results of the assessments of more accurate estimators regarding the PRE-application importance of drivers. The PRE-application importance of 13 out of 33 drivers exceeded a pre-determined cut-off point (> 0.8). Among the 13 identified drivers, six drivers belong to the category of Project Basic Facts-related drivers: #1 (TxDOT Project Type), #4 (Right-of-Way and Utility Scope), #7 (Status of Environmental Clearance), #8 (Status of Right-of-Way Map), #11 (Dedication of Funds to the Project), and #14 (Funding Limitations for the Project).

The remaining seven drivers are included in the group R/W Acquisition-related drivers. These drivers include: #19 (Number of Parcels for Acquisition), #21 (Frequency of Eminent Domain), #28 (Need for Residential Relocation), #29 (Level of Local Availability of Replacement Housing Facilities), #31 (Level of Local Availability of Replacement Business Facilities), #32 (Likelihood of Title Curative Actions), and #33 (Responsiveness of Local Title Companies to TxDOT).

Table 7.32: Driver's PRE-Application Importance Assessments of More Accurate Estimators in Non-RUDI-based R/W Acquisition Duration Estimation

Category	Driver (n=33)	Description	Mean (n=14)	Rank
B	D14	Funding Limitations for the Project	0.952	1
R	D28	Need for Residential Relocation	0.929	2
B	D7	Status of Environmental Clearance	0.929	2
R	D21	Frequency of Eminent Domain	0.929	4
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.929	4
R	D29	Level of Local Availability of Replacement Housing Facilities	0.905	6
R	D32	Likelihood of Title Curative Actions	0.905	7
R	D19	Number of Parcels for Acquisition	0.857	8
B	D1	TxDOT Project Type	0.857	8
B	D8	Status of Right-of-Way Map	0.857	10
R	D31	Level of Local Availability of Replacement Business Facilities	0.810	11
B	D4	Right-of-Way and Utility Scope	0.810	11
R	D33	Responsiveness of Local Title Companies to TxDOT	0.810	13
B	D18	Current Status of the R/W Project	0.762	14
R	D24	Is Funding Available for Outsourcing Staff Assistance?	0.738	15
R	D27	Are There Any Property Tenants to Consider?	0.738	16
B	D15	Level of Acceptance of the Project by the Public	0.714	17
B	D12	LPA Funded or Non-LPA Funded	0.714	17
B	D17	Common Concerns of Property Owners	0.690	19
B	D2	TxDOT Highway Type	0.690	19
B	D13	Federally Funded or Non-Federally Funded	0.667	21
R	D22	Source of Personnel to be used for R/W Acquisition	0.667	22
R	D20	Different Types of Parcel Usages	0.667	22
B	D3	Project Location Type	0.667	22
R	D25	Type of Property Owners	0.643	25
R	D30	Need for Business Relocation	0.643	26
B	D16	Level of Political Pressure	0.643	26
R	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.619	28
B	D6	Status of Boundary Surveying	0.619	28
B	D10	District R/W Annual Budget	0.595	30
B	D9	Internal R/W Staff Size of a District	0.571	31
R	D26	Level of Familiarity with Key Landowners	0.571	32
B	D5	Status of Schematic Design	0.524	33

* B: Project Basic Facts-related, R: R/W Acquisition-related, and Utility Adjustment-related

b. Drivers Deemed Important by Less Accurate Estimators

Nine drivers were evaluated by Less Accurate estimators as having high importance exceeding the threshold (> 0.8), and these data are presented in Table 7.33. Six out of these nine duration drivers are related to Project Basic Facts. These drivers include:

- Right-of-Way and Utility Scope (D4)
- Status of Boundary Surveying (D6)
- Status of Environmental Clearance (D7)
- Status of Right-of-Way Map (D8)
- District R/W Annual Budget (D10)
- Common Concerns of Property Owners (D17)

Among the Utility Adjustment-related drivers, drivers #30 (Need for Business Relocation), #21 (Frequency of Eminent Domain), and #19 (Number of Parcels for Acquisition) were considered to be highly important by Less Accurate estimators. As described in Table 7.33, some of these nine drivers were also recognized as highly important drivers exceeding the cut-off (> 0.8) by More Accurate estimators. These estimators' agreement was tested with comparative analyses using the chi-square test and descriptive statistics. The results are described in the following section.

Table 7.33: Driver's PRE-Application Importance Assessments of Less Accurate Estimators in Non-RUDI-based R/W Acquisition Duration Estimation

Category	Driver (n=33)	Description	Mean (n=12)	Rank
B	D8	Status of Right-of-Way Map	0.889	1
B	D4	Right-of-Way and Utility Scope	0.861	2
R	D30	Need for Business Relocation	0.833	3
B	D7	Status of Environmental Clearance	0.833	3
B	D10	District R/W Annual Budget	0.833	5
R	D21	Frequency of Eminent Domain	0.806	6
R	D19	Number of Parcels for Acquisition	0.806	6
B	D17	Common Concerns of Property Owners	0.806	8
B	D6	Status of Boundary Surveying	0.806	8
R	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.750	10
R	D31	Level of Local Availability of Replacement Business Facilities	0.750	11
R	D27	Are There Any Property Tenants to Consider?	0.750	11
B	D9	Internal R/W Staff Size of a District	0.750	11
B	D5	Status of Schematic Design	0.722	14
R	D24	Is Funding Available for Outsourcing Staff Assistance?	0.722	15
B	D18	Current Status of the R/W Project	0.722	16
R	D20	Different Types of Parcel Usages	0.694	17
B	D15	Level of Acceptance of the Project by the Public	0.694	17
B	D3	Project Location Type	0.694	17
R	D33	Responsiveness of Local Title Companies to TxDOT	0.667	20
R	D22	Source of Personnel to be used for R/W Acquisition	0.667	20
B	D2	TxDOT Highway Type	0.667	20
R	D32	Likelihood of Title Curative Actions	0.639	23
R	D25	Type of Property Owners	0.639	23
B	D13	Federally Funded or Non-Federally Funded	0.611	25
B	D14	Funding Limitations for the Project	0.611	26
B	D1	TxDOT Project Type	0.611	26
R	D26	Level of Familiarity with Key Landowners	0.583	28
R	D28	Need for Residential Relocation	0.583	29
B	D12	LPA Funded or Non-LPA Funded	0.556	30
R	D29	Level of Local Availability of Replacement Housing Facilities	0.528	31
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.500	32
B	D16	Level of Political Pressure	0.417	33

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

c. Comparative Analysis

One of the objectives of this study was to identify what drivers really make a difference in forecasting R/W acquisition and utility adjustment, as mentioned in Chapter 1. In order to achieve this objective, this study compared the PRE-application importance assessments of More Accurate estimators with those of Less Accurate estimators.

Table 7.34 describes the differences between More Accurate and Less Accurate estimators' assessments of the PRE-application importance of duration drivers related to both Project Basic Facts and R/W Acquisition. The drivers exceeding the cut-off point (> 0.2) are: #1 (TxDOT Project Type), #10 (District R/W Annual Budget), #11 (Dedication of Funds to the Project), #14 (Funding Limitations for the Project), #16 (Level of Political Pressure), #28 (Need for Residential Relocation), #29 (Level of Local Availability of Replacement Housing Facilities), and #32 (Likelihood of Title Curative Actions).

Among these drivers, drivers #14, #28, #11, #29, #32, #1, and #16 were evaluated as having relatively high importance by More Accurate estimators, and the remaining driver #10 was only considered more important by Less Accurate estimators as compared to More Accurate ones. Because of the divergence among estimators' rankings, this result indicates that More Accurate and Less Accurate estimators have significantly different perceptions of the importance of the drivers showing large differences (> 0.2) in the importance assessments.

These differences that emerged between these two groups needed to be validated in order to determine if the discrepancies were statistically significant or not. If they are significant, it could be said that these two groups have different perceptions of the importance of the drivers when predicting the durations of R/W acquisition process.

The chi-square test was used to make this determination, and detailed results of this test are described in the following section.

Table 7.34: Comparison: PRE-Application Importance of Drivers for R/W Acquisition Duration (More vs. Less Accurate Estimators in Non-RUDI-based)

Cate.	Driver (n=33)	Description	PRE-Application Importance					
			More Mean (n=14)	Less Mean (n=12)	Mean Difference (M-L)	More Rank (n=14)	Less Rank (n=12)	Rank Difference (M-L)
B	D14	Funding Limitations for the Project	0.952	0.611	0.341	1	26	– 25
R	D28	Need for Residential Relocation	0.929	0.583	0.346	2	29	– 27
B	D7	Status of Environmental Clearance	0.929	0.833	0.096	2	3	– 1
R	D21	Frequency of Eminent Domain	0.929	0.806	0.123	4	6	– 2
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.929	0.500	0.429	4	32	– 28
R	D29	Level of Local Availability of Replacement Housing Facilities	0.905	0.528	0.377	6	31	– 25
R	D32	Likelihood of Title Curative Actions	0.905	0.639	0.266	7	23	– 16
R	D19	Number of Parcels for Acquisition	0.857	0.806	0.051	8	6	2
B	D1	TxDOT Project Type	0.857	0.611	0.246	8	26	– 18
B	D8	Status of Right-of-Way Map	0.857	0.889	– 0.032	10	1	9
R	D31	Level of Local Availability of Replacement Business Facilities	0.810	0.750	0.060	11	11	0
B	D4	Right-of-Way and Utility Scope	0.810	0.861	– 0.051	11	2	9
R	D33	Responsiveness of Local Title Companies to TxDOT	0.810	0.667	0.143	13	20	– 7
B	D18	Current Status of the R/W Project	0.762	0.722	0.040	14	16	– 2
R	D24	Is Funding Available for Outsourcing Staff Assistance?	0.738	0.722	0.016	15	15	0
R	D27	Are There Any Property Tenants to Consider?	0.738	0.750	– 0.012	16	11	5
B	D15	Level of Acceptance of the Project by the Public	0.714	0.694	0.020	17	17	0
B	D12	LPA Funded or Non-LPA Funded	0.714	0.556	0.158	17	30	– 13
B	D17	Common Concerns of Property Owners	0.690	0.806	– 0.116	19	8	11
B	D2	TxDOT Highway Type	0.690	0.667	0.023	19	20	– 1
B	D13	Federally Funded or Non-Federally Funded	0.667	0.611	0.056	21	25	– 4
R	D22	Source of Personnel to be used for R/W Acquisition	0.667	0.667	0.000	22	20	2
R	D20	Different Types of Parcel Usages	0.667	0.694	– 0.027	22	17	5
B	D3	Project Location Type	0.667	0.694	– 0.027	22	17	5
R	D25	Type of Property Owners	0.643	0.639	0.004	25	23	2
R	D30	Need for Business Relocation	0.643	0.833	– 0.190	26	3	23
B	D16	Level of Political Pressure	0.643	0.417	0.226	26	33	– 7
R	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.619	0.750	– 0.131	28	10	18
B	D6	Status of Boundary Surveying	0.619	0.806	– 0.187	28	8	20
B	D10	District R/W Annual Budget	0.595	0.833	– 0.238	30	5	25
B	D9	Internal R/W Staff Size of a District	0.571	0.750	– 0.179	31	11	20
R	D26	Level of Familiarity with Key Landowners	0.571	0.583	– 0.012	32	28	4
B	D5	Status of Schematic Design	0.524	0.722	– 0.198	33	14	19

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

Table 7.35 shows that More Accurate and Less Accurate estimators had different perceptions of the PRE-application importance of the following duration drivers related to Project Basic Facts and R/W Acquisition. In the chi-square test, since the minimum expected counts in a cell should be 5, the Fisher's exact statistic should be used to get a more accurate result as well as in order to increase the accuracy of the chi-square statistics produced. Although conventionally, the significance value should be less than 0.05, and the values exceeding 0.05 could be meaningful. In other words, if a *p*-value is of near-borderline significance, it can be said that observed differences, although not statistically significant, are practically meaningful to the practitioners. Moreover, if the sample size were increased, there is a high likelihood that the difference can reach statistical significance (Potter 1994).

All drivers that showed large differences in the previous comparative analysis presented differences that were either statistically or practically significant in the chi-square test as described in Table 7.35. Along with the significance levels testing conducted with a chi-square test, gamma (G) for each driver was also calculated to present the strength of the association between the accuracy of non-RUDI-based R/W acquisition duration and the importance of drivers. According to convention, a gamma value of greater than 0.3 is designated for a strong relationship and a value between 0.1 and 0.3 is considered a moderate association.

As described in Table 7.35, except for driver #20 (Different Types of Parcel Usages), the remaining drivers' gamma values varied from a value of – 0.72 to a value of 1.0. These gamma values indicate that there is a very strong relationship between the accuracy of duration estimation and the driver importance, but some relationships are in a negative direction. That is, as the accuracy of duration estimation decreases, the importance of drivers are evaluated as being more than "Moderate" or "High."

Table 7.35: Chi-square Test Results: Associations among PRE-Application Importance of Project Basic Facts and R/W Acquisition-related Drivers and Accuracy of Non-RUDI-based R/W Acquisition Duration Estimation

Driver	Description	Accuracy of Estimation	Level of Importance				G	Chi-Square (Sig.*P*)	Exact Test (Sig.*P*)
			Not Important	Low	Moderate	High			
D1	TxDOT Project Type	Less	0	5	4	3	0.66	.061	.084
		More	0	2	2	10			
D10	District R/W Annual Budget	Less	0	2	2	8	–0.58	.074	.064
		More	2	2	7	3			
D11	Dedication of Funds to the Project (R/W and Construction)	Less	0	8	2	2	0.91	.002	.001
		More	0	1	1	12			
D14	Funding Limitations for the Project	Less	0	6	2	4	0.86	.007	.003
		More	0	0	2	12			
D16	Level of Political Pressure	Less	4	4	1	3	0.43	.003	.001
		More	0	2	11	1			
D17	Common Concerns of Property Owners	Less	0	2	3	7	–0.46	.023	.020
		More	0	1	11	2			
D20	Different Types of Parcel Usages	Less	0	1	9	2	–0.07	.056	.084
		More	0	5	4	5			
D28	Need for Residential Relocation	Less	0	5	5	2	0.86	.002	.002
		More	0	1	1	12			
D29	Level of Local Availability of Replacement Housing Facilities	Less	0	7	3	2	0.86	.004	.002
		More	0	1	2	11			
D30	Need for Business Relocation	Less	0	1	4	7	–0.72	.018	.012
		More	0	2	11	1			
D32	Likelihood of Title Curative Actions	Less	0	1	11	0	1.00	.001	.001
		More	0	0	4	10			

The previous comparative studies also revealed that these drivers with significant differences can be considered the key drivers that differentiate More Accurate estimators from Less Accurate ones in R/W acquisition duration estimation. The result is one of the most important findings from this study. The importance of these drivers was considered to be one of the main findings in the subsequent analyses of the POST-application importance. This importance is further validated in Chapter 9.

7.5.2.2 Utility Adjustment Durations

a. Drivers Deemed Important by More Accurate Estimators

Table 7.36 shows the results of the PRE-application driver importance assessments of More Accurate estimators in utility adjustment duration estimation. As mentioned earlier, there are 18 and 9 drivers, respectively, related to Project Basic Facts and Utility Adjustment. Among these drivers, eight drivers #4 (Right-of-Way and Utility Scope), #7 (Status of Environmental Clearance), #8 (Status of Right-of-Way Map), #11 (Dedication of Funds to the Project), #14 (Funding Limitations for the Project), #18 (Current Status of the R/W Project), #38 (Number of Utilities Located in Private Easement), and #41 (Responsiveness of Utility Companies to TxDOT Needs) exceeded the cut-off (> 0.8). Drivers # 41 (Responsiveness of Utility Companies to TxDOT Needs) and #38 (Number of Utilities Located in Private Easement) are related to utility adjustment. The remaining six duration drivers are related to Project Basic Facts.

Table 7.36: Driver's PRE-Application Importance Assessments of More Accurate Estimators in Non-RUDI-based Utility Adjustment Duration Estimation

Category	Driver (n=27)	Description	Mean (n=14)	Rank
B	D8	Status of Right-of-Way Map	0.952	1
B	D7	Status of Environmental Clearance	0.929	2
B	D14	Funding Limitations for the Project	0.929	3
U	D41	Responsiveness of Utility Companies to TxDOT Needs	0.905	4
U	D38	Number of Utilities Located in Private Easement	0.857	5
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.833	6
B	D4	Right-of-Way and Utility Scope	0.833	6
B	D18	Current Status of the R/W Project	0.810	8
B	D17	Common Concerns of Property Owners	0.786	9
B	D10	District R/W Annual Budget	0.786	9
U	D39	Number of Utilities for Adjustments or Relocations	0.786	11
U	D37	Number of Utilities Located in Public R/W	0.762	12
U	D36	Utility Type	0.762	12
B	D6	Status of Boundary Surveying	0.738	14
B	D1	TxDOT Project Type	0.714	15
B	D15	Level of Acceptance of the Project by the Public	0.714	16
U	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.690	17
B	D16	Level of Political Pressure	0.667	18
B	D5	Status of Schematic Design	0.643	19
B	D9	Internal R/W Staff Size of a District	0.643	20
U	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.619	21
B	D12	LPA Funded or Non-LPA Funded	0.595	22
B	D3	Project Location Type	0.595	22
B	D13	Federally Funded or Non-Federally Funded	0.571	24
B	D2	TxDOT Highway Type	0.571	24
U	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.571	26
U	D34	Have SUE Investigations Been Performed?	0.476	27

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

b. Drivers Deemed Important by Less Accurate Estimators

In the PRE-application importance assessments of Less Accurate estimators, 10 drivers were evaluated as having high importance exceeding the cut-off (> 0.8), as illustrated in Table 7.37. Four drivers #4 (Right-of-Way and Utility Scope), #7 (Status of Environmental Clearances), #8 (Status of Right-of-Way Map), and #17 (Common

Concerns of Property Owners) out of these 10 drivers are related to Project Basic Facts, and the remaining six drivers #39 (Number of Utilities for Adjustments or Relocations), #37 (Number of Utilities Located in Public R/W), #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility), #41 (Responsiveness of Utility Companies to TxDOT Needs), #38 (Number of Utilities Located in Private Easement), and #34 (Have SUE Investigations been performed?) are related to Utility Adjustment. Two different statistical approaches were utilized in order to investigate differences between More Accurate and Less Accurate estimators in assessing the PRE-application importance of these 27 drivers. The results are described in the following paragraph.

Table 7.37: Driver's PRE-Application Importance Assessments of Less Accurate Estimators in Non-RUDI-based Utility Adjustment Duration Estimation

Category	Driver (n=27)	Description	Mean (n=11)	Rank
U	D39	Number of Utilities for Adjustments or Relocations	0.939	1
U	D37	Number of Utilities Located in Public R/W	0.939	1
U	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.939	3
U	D41	Responsiveness of Utility Companies to TxDOT Needs	0.909	4
B	D4	Right-of-Way and Utility Scope	0.879	5
U	D38	Number of Utilities Located in Private Easement	0.879	6
U	D34	Have SUE Investigations Been Performed?	0.879	6
B	D7	Status of Environmental Clearance	0.848	8
B	D8	Status of Right-of-Way Map	0.818	9
B	D17	Common Concerns of Property Owners	0.818	10
U	D36	Utility Type	0.788	11
B	D18	Current Status of the R/W Project	0.788	11
B	D9	Internal R/W Staff Size of a District	0.788	11
B	D6	Status of Boundary Surveying	0.788	11
B	D10	District R/W Annual Budget	0.758	15
B	D2	TxDOT Highway Type	0.758	15
U	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.727	17
B	D15	Level of Acceptance of the Project by the Public	0.727	17
B	D5	Status of Schematic Design	0.727	17
B	D13	Federally Funded or Non-Federally Funded	0.697	20
U	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.667	21
B	D12	LPA Funded or Non-LPA Funded	0.667	21
B	D3	Project Location Type	0.667	21
B	D1	TxDOT Project Type	0.636	24
B	D14	Funding Limitations for the Project	0.576	25
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.576	25
B	D16	Level of Political Pressure	0.485	27

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

c. Comparative Analysis

As described in Table 7.38, drivers #11 (Dedication of Funds to the Project: R/W and Construction), #14 (Funding Limitations for the Project), #34 (Have SUE Investigations been Performed?), and #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility), were identified as drivers with large differences exceeding the cut-off (> 0.2) in the comparative analysis of both More and Less Accurate estimators. Significantly different perceptions of these drivers' importance may have caused differences in the accuracy of estimators when estimating the durations of the utility adjustment process. Similar to the R/W acquisition duration estimation, these drivers were also evaluated using a chi-square test to see if these differences are statistically or practically significant.

Table 7.38: Comparison: PRE-Application Importance of Drivers for Utility Adjustment Duration (More vs. Less Accurate Estimators in Non-RUDI-based)

Cate.	Driver (n=27)	Description	PRE-Application Importance					
			More Mean (n=14)	Less Mean (n=11)	Mean Difference (M-L)	More Rank (n=14)	Less Rank (n=11)	Rank Difference (M-L)
B	D8	Status of Right-of-Way Map	0.952	0.818	0.134	1	9	– 8
B	D7	Status of Environmental Clearance	0.929	0.848	0.081	2	8	– 6
B	D14	Funding Limitations for the Project	0.929	0.576	0.353	3	25	– 22
U	D41	Responsiveness of Utility Companies to TxDOT Needs	0.905	0.909	– 0.004	4	4	0
U	D38	Number of Utilities Located in Private Easement	0.857	0.879	– 0.022	5	6	– 1
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.833	0.576	0.257	6	25	– 19
B	D4	Right-of-Way and Utility Scope	0.833	0.879	– 0.046	6	5	1
B	D18	Current Status of the R/W Project	0.810	0.788	0.022	8	11	– 3
B	D17	Common Concerns of Property Owners	0.786	0.818	– 0.032	9	10	– 1
B	D10	District R/W Annual Budget	0.786	0.758	0.028	9	15	– 6
U	D39	Number of Utilities for Adjustments or Relocations	0.786	0.939	– 0.153	11	1	10
U	D37	Number of Utilities Located in Public R/W	0.762	0.939	– 0.177	12	1	11
U	D36	Utility Type	0.762	0.788	– 0.026	12	11	1
B	D6	Status of Boundary Surveying	0.738	0.788	– 0.050	14	11	3
B	D1	TxDOT Project Type	0.714	0.636	0.078	15	24	– 9
B	D15	Level of Acceptance of the Project by the Public	0.714	0.727	– 0.013	16	17	– 1
U	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.690	0.667	0.023	17	21	– 4
B	D16	Level of Political Pressure	0.667	0.485	0.182	18	27	– 9
B	D5	Status of Schematic Design	0.643	0.727	– 0.084	19	11	8
B	D9	Internal R/W Staff Size of a District	0.643	0.788	– 0.145	20	11	9
U	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.619	0.939	– 0.320	21	3	18
B	D12	LPA Funded or Non-LPA Funded	0.595	0.667	– 0.072	22	21	1
B	D3	Project Location Type	0.595	0.667	– 0.072	22	21	1
B	D13	Federally Funded or Non-Federally Funded	0.571	0.697	– 0.126	24	20	4
B	D2	TxDOT Highway Type	0.571	0.758	– 0.187	24	15	9
U	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.571	0.727	0.156	26	17	9
U	D34	Have SUE Investigations Been Performed?	0.476	0.879	– 0.403	27	6	21

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

As depicted in Table 7.39, Drivers #11 (Dedication of Funds to the Project), #14 (Funding Limitations for the Project), #34 (Have SUE Investigations been performed?), and #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility) were also evaluated as having large differences that are statistically or practically important in the chi-square test. The *p*-values of drivers #14, #34, and #42 are far less than the significance level (< 0.05), which is the conventional threshold to determine statistical significance. Although the remaining driver, #11, did not show a statistical significance level, this level of difference can also be considered practically important. Similar to the R/W Acquisition duration drivers results discussed in the analysis above, these four drivers can also be considered drivers capable of differentiating More Accurate estimators from Less Accurate ones in estimating the durations of the utility adjustment process. In addition, the *p*-values of drivers #6 (Status of Boundary Surveying), #13 (Federally Funded or Non-Federally Funded), #16 (Level of Political Pressure), #37 (Number of Utilities Located in Public R/W), and #39 (Number of Utilities for Adjustments or Relocations) are small enough to be considered statistically or practically important even though their differences in the descriptively comparative analysis did not exceed the targeted cut-off point (> 0.2).

In addition to the chi-square test statistics, as described in Table 7.39, most gamma values are more than 0.3, which is a conventional cut-off point for a strong association between variables. Moreover, the relationships of drivers #13, #34, #37, #39, and #42 are in a negative direction. In other words, the importance of these drivers is evaluated as being "Moderate" or "High" as the accuracy of duration estimation increases.

Table 7.39: Chi-square Test Results: Associations among PRE-Application Importance of Project Basic Facts and Utility Adjustment-related Drivers and Accuracy of Non-RUDI-based Utility Adjustment Duration Estimation

Driver	Description	Accuracy of Estimation	Level of Importance				G	Chi-Square (Sig.*P*)	Exact Test (Sig.*P*)
			Not Important	Low	Moderate	High			
D6	Status of Boundary Surveying	Less	0	0	7	4	0.03	.049	.036
		More	1	3	2	8			
D11	Dedication of Funds to the Project (R/W and Construction)	Less	0	6	2	3	0.65	.086	.094
		More	0	2	3	9			
D13	Federally Funded or Non-Federally Funded	Less	0	3	4	4	–0.30	.068	.089
		More	2	1	10	1			
D14	Funding Limitations for the Project	Less	0	6	2	3	0.84	.005	.003
		More	0	0	3	11			
D16	Level of Political Pressure	Less	4	1	3	3	0.30	.083	.102
		More	0	4	6	4			
D34	Have SUE Investigations Been Performed?	Less	0	1	2	8	–0.87	.005	.003
		More	0	10	2	2			
D37	Number of Utilities Located in Public R/W	Less	0	0	2	9	–0.87	.008	.015
		More	0	0	10	4			
D39	Number of Utilities for Adjustments or Relocations	Less	0	1	0	10	–0.72	.021	.009
		More	0	1	7	6			
D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	Less	0	0	2	9	–0.81	.019	.010
		More	0	7	2	5			

7.5.3 Associations: POST-Application Importance and Duration Estimation Accuracy

Along with identifying the most differentiating drivers in estimating R/W acquisition duration through the assessments of the PRE-application importance of drivers, an analysis of the assessments of the POST-application importance of drivers on the basis of the accuracy of non-RUDI-based duration estimation was also conducted using the same approaches. Unlike the PRE-application assessment, however, when practitioners assessed the POST-application importance of drivers, specific information was given about each of the drivers.

7.5.3.1 R/W Acquisition Durations

a. Drivers Deemed Important by More Accurate Estimators

Table 7.40 describes the results of the POST-application driver importance assessments of More Accurate estimators. The importance levels assigned in these assessments ranged from 1.0 to 0.286. This large variability in the importance levels did not appear in these same estimators' PRE-application driver importance assessments. One of the possible reasons for this distinction in variability between the PRE-application and the POST-application importance assessments is that the evaluated drivers had specific real values with which the practitioners could work POST-application.

There are five drivers that exceeded the cut-off point (> 0.8) in this category. Drivers #19 (Number of Parcels for Acquisition), #21 (Frequency of Eminent Domain), #31 (Level of Local Availability of Replacement Business Facilities), and #32 (Likelihood of Title Curative Actions) are related to R/W Acquisition, and the remaining driver, #3 (Project Location Type), is related to Project Basic Facts. These results were compared with the More Accurate estimators' PRE-application importance assessments of these same drivers to see if specific project values may have caused changes in the designation of driver importance. This comparison was conducted using a McNemar's test, and the results are described in Section 7.6.

Table 7.40: Driver's POST-Application Importance Assessments of More Accurate Estimators in Non-RUDI-based R/W Acquisition Duration Estimation

Category	Driver (n=33)	Description	Mean (n=14)	Rank
R	D21	Frequency of Eminent Domain	1.000	1
R	D19	Number of Parcels for Acquisition	0.929	2
B	D3	Project Location Type	0.929	2
R	D32	Likelihood of Title Curative Actions	0.857	4
R	D31	Level of Local Availability of Replacement Business Facilities	0.857	4
R	D26	Level of Familiarity with Key Landowners	0.786	6
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.786	7
R	D28	Need for Residential Relocation	0.714	8
B	D4	Right-of-Way and Utility Scope	0.714	8
B	D1	TxDOT Project Type	0.714	8
R	D30	Need for Business Relocation	0.714	11
R	D29	Level of Local Availability of Replacement Housing Facilities	0.714	11
B	D10	District R/W Annual Budget	0.714	11
R	D25	Type of Property Owners	0.643	14
B	D18	Current Status of the R/W Project	0.643	14
B	D7	Status of Environmental Clearance	0.643	14
R	D33	Responsiveness of Local Title Companies to TxDOT	0.571	17
R	D24	Is Funding Available for Outsourcing Staff Assistance?	0.571	17
B	D6	Status of Boundary Surveying	0.571	17
B	D5	Status of Schematic Design	0.571	17
R	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.500	21
R	D22	Source of Personnel to be used for R/W Acquisition	0.500	21
B	D14	Funding Limitations for the Project	0.500	21
B	D9	Internal R/W Staff Size of a District	0.500	21
B	D8	Status of Right-of-Way Map	0.500	21
B	D2	TxDOT Highway Type	0.429	26
B	D13	Federally Funded or Non-Federally Funded	0.429	27
R	D20	Different Types of Parcel Usages	0.357	28
R	D27	Are There Any Property Tenants to Consider?	0.357	29
B	D15	Level of Acceptance of the Project by the Public	0.357	29
B	D12	LPA Funded or Non-LPA Funded	0.357	29
B	D17	Common Concerns of Property Owners	0.357	32
B	D16	Level of Political Pressure	0.286	33

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

b. Drivers Deemed Important by Less Accurate Estimators

The POST-application importance assessment results of the Less Accurate estimators on the drivers related to Project Basic Facts and R/W Acquisition are described in Table 7.41. These importance levels ranged from 1.0 to 0.083. All the Less Accurate estimators considered driver #4 (Right-of-Way and Utility Scope) critical in predicting the durations of the R/W acquisition process. Along with driver #4 (Right-of-Way and Utility Scope), two additional drivers, #19 (Number of Parcels for Acquisition) and #29 (Level of Local Availability of Replacement Housing Facilities), were evaluated as having high importance, more than 0.8. In contrast, driver #16 (Level of Political Pressure) was perceived to be less significant by Less Accurate estimators.

This assessment was also compared with the Less Accurate estimators' PRE-application importance assessments using a McNemar's test to identify what drivers were significantly influenced by their values in a real highway project. The results are depicted in Section 7.6.

Table 7.41: Driver's POST-Application Importance Assessments of Less Accurate Estimators in Non-RUDI-based R/W Acquisition Duration Estimation

Category	Driver (n=33)	Description	Mean (n=12)	Rank
B	D4	Right-of-Way and Utility Scope	1.000	1
R	D29	Level of Local Availability of Replacement Housing Facilities	0.833	2
R	D19	Number of Parcels for Acquisition	0.833	3
R	D28	Need for Residential Relocation	0.750	4
R	D27	Are There Any Property Tenants to Consider?	0.750	4
R	D32	Likelihood of Title Curative Actions	0.750	6
R	D30	Need for Business Relocation	0.750	6
B	D18	Current Status of the R/W Project	0.750	6
B	D8	Status of Right-of-Way Map	0.667	9
B	D7	Status of Environmental Clearance	0.667	9
R	D33	Responsiveness of Local Title Companies to TxDOT	0.583	11
R	D24	Is Funding Available for Outsourcing Staff Assistance?	0.583	11
R	D20	Different Types of Parcel Usages	0.583	11
B	D6	Status of Boundary Surveying	0.583	14
B	D3	Project Location Type	0.583	14
B	D2	TxDOT Highway Type	0.500	16
R	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.500	17
B	D14	Funding Limitations for the Project	0.500	17
B	D12	LPA Funded or Non-LPA Funded	0.500	17
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.500	17
B	D5	Status of Schematic Design	0.500	17
B	D17	Common Concerns of Property Owners	0.417	22
R	D25	Type of Property Owners	0.417	23
R	D22	Source of Personnel to be used for R/W Acquisition	0.417	23
B	D15	Level of Acceptance of the Project by the Public	0.417	23
B	D10	District R/W Annual Budget	0.417	23
B	D9	Internal R/W Staff Size of a District	0.417	23
B	D16	Level of Political Pressure	0.333	28
R	D26	Level of Familiarity with Key Landowners	0.250	29
R	D21	Frequency of Eminent Domain	0.250	29
B	D1	TxDOT Project Type	0.250	31
B	D13	Federally Funded or Non-Federally Funded	0.250	32
R	D31	Level of Local Availability of Replacement Business Facilities	0.083	33

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

c. Comparative Analysis

A comparative analysis was conducted to investigate the More and Less Accurate estimators' assessments of the POST-application importance of both the Project Basic Facts and R/W Acquisition-related drivers. As described in Table 7.42, there are 11 drivers that exceeded the cut-off point (> 0.2). More and Less Accurate estimators' rankings showed the largest difference (> 0.75) for Drivers #21 and #31. Specifically, all of the More Accurate estimators in R/W acquisition duration estimation considered "#21 (Frequency of Eminent Domain)" to be the most important driver because project B had a high possibility of requiring eminent domain in order to acquire properties. However, this driver was not perceived as important by Less Accurate estimators, as described in Table 7.42. Driver #31 (Level of Local Availability of Replacement Business Facilities) was also evaluated as having high (0.857) importance by most More Accurate estimators, but in the assessments of Less Accurate estimators, it was the driver with the lowest importance (0.083).

The great differences revealed by this comparative analysis mean that More Accurate and Less Accurate estimators have large differences in their assessments of the importance of Project Basic Facts and R/W Acquisition-related drivers when these estimators have specific information about the R/W acquisition duration estimation. These findings were re-tested by a chi-square test illustrated in the following table.

Table 7.42: Comparison: POST-Application Importance of Drivers for R/W Acquisition Duration (More vs. Less Accurate Estimators in Non-RUDI-based)

Cate.	Driver (n=33)	Description	Project Value	POST-Application Importance		
				More Mean (n=14)	Less Mean (n=12)	Mean Difference (M-L)
R	D21	Frequency of Eminent Domain	Several	1.000	0.250	0.750
R	D19	Number of Parcels for Acquisition		0.929	0.833	0.096
B	D3	Project Location Type	Rural	0.929	0.583	0.346
R	D32	Likelihood of Title Curative Actions		0.857	0.750	0.107
R	D31	Level of Local Availability of Replacement Business Facilities	Low	0.857	0.083	0.774
R	D26	Level of Familiarity with Key Landowners	High	0.786	0.250	0.536
B	D11	Dedication of Funds to the Project (R/W and Construction)	Yes	0.786	0.500	0.286
R	D28	Need for Residential Relocation		0.714	0.750	– 0.036
B	D4	Right-of-Way and Utility Scope	R/W acquisition and Utility Adjustment	0.714	1.000	– 0.286
B	D1	TxDOT Project Type	RER	0.714	0.250	0.464
R	D30	Need for Business Relocation		0.714	0.750	– 0.036
R	D29	Level of Local Availability of Replacement Housing Facilities		0.714	0.833	– 0.119
B	D10	District R/W Annual Budget	Less than $6million	0.714	0.417	0.297
R	D25	Type of Property Owners	Some out-of-state	0.643	0.417	0.226
B	D18	Current Status of the R/W Project		0.643	0.750	– 0.107
B	D7	Status of Environmental Clearance		0.643	0.667	– 0.024
R	D33	Responsiveness of Local Title Companies to TxDOT		0.571	0.583	– 0.012
R	D24	Is Funding Available for Outsourcing Staff Assistance?		0.571	0.583	– 0.012
B	D6	Status of Boundary Surveying		0.571	0.583	– 0.012
B	D5	Status of Schematic Design		0.571	0.500	0.071
R	D23	Availability of District R/W Appraisers (District Staff and Outsourced)		0.500	0.500	0.000
R	D22	Source of Personnel to be used for R/W Acquisition		0.500	0.417	0.083
B	D14	Funding Limitations for the Project		0.500	0.500	0.000
B	D9	Internal R/W Staff Size of a District		0.500	0.417	0.083
B	D8	Status of Right-of-Way Map		0.500	0.667	– 0.167
B	D2	TxDOT Highway Type		0.429	0.500	– 0.071
B	D13	Federally Funded or Non-Federally Funded		0.429	0.250	0.179
R	D20	Different Types of Parcel Usages	Residential & Commercial	0.357	0.583	– 0.226
R	D27	Are There Any Property Tenants to Consider?	No	0.357	0.750	– 0.393
B	D15	Level of Acceptance of the Project by the Public		0.357	0.417	– 0.060
B	D12	LPA Funded or Non-LPA Funded		0.357	0.500	– 0.143
B	D17	Common Concerns of Property Owners		0.357	0.417	– 0.060
B	D16	Level of Political Pressure		0.286	0.333	– 0.047

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

As described in Table 7.43, the drivers identified as having large differences in the comparative analysis above showed statistical or practical significance levels in the chi-square test. Therefore, it can be said that experts with different levels of predictive accuracy have significant differences in their assessments of the POST-application importance of the drivers necessary to estimate the durations of the R/W acquisition process. Moreover, all the values of gamma (G) indicate that there is a strong relationship between the accuracy of non-RUDI-based R/W acquisition duration estimation of the importance of these drivers. Additionally, except for drivers #4, #21, and #27, the odds ratios of the remaining drivers indicate estimators with the worst predictive accuracy of duration are more likely to consider the importance of drivers to being "Not Important" than estimators with high predictive accuracy of duration, as described in Table 7.43. However, employing this result should be limited because finings could be affected by Project B's biases. Therefore, testing additional highway projects based on this approach is a necessary step to improve the reliability of the study.

Table 7.43: Chi-square Test Results: Associations among POST-Application Importance of Project Basic Facts and R/W Acquisition-related Drivers and Accuracy of Non-RUDI-based R/W Acquisition Duration Estimation

Driver	Description	Accuracy of Estimation	Level of Importance		G	OR	Chi-Square (Sig.*P*)	Exact Test (Sig.*P*)
			Not Important	Important				
D1	TxDOT Project Type	Less	9	3	0.76	7.5	.018	.047
		More	4	10				
D3	Project Location Type	Less	5	7	0.80	9.2	.037	.065
		More	1	13				
D4	Right-of-Way and Utility Scope	Less	0	12	–1.00	0.0	.044	.100
		More	4	10				
D21	Frequency of Eminent Domain	Less	9	3	1.00	0.0	.001	.001
		More	0	14				
D26	Level of Familiarity with Key Landowners	Less	9	3	0.83	11	.006	.016
		More	3	11				
D27	Are There Any Property Tenants to Consider?	Less	3	9	–0.68	0.18	.045	.062
		More	9	5				
D31	Level of Local Availability of Replacement Business Facilities	Less	11	1	0.97	66	.001	.001
		More	2	12				

7.5.3.2 Utility Adjustment Durations

a. Drivers Deemed Important by More Accurate Estimators

For utility adjustment duration estimation, twenty-seven drivers related to Project Basic Facts and Utility Adjustment were evaluated by More Accurate estimators as described in Table 7.44. The importance level assigned to these drivers ranged from 0.929 (#41: Responsiveness of Utility Companies to TxDOT Needs and #38: Number of Utilities Located in Private Easement) to 0.143 (#17: Common Concerns of Property Owners and #39: Number of Utilities for Adjustments or Relocations). In addition, only four drivers were evaluated as having high importance (> 0.8). Drivers #41 (Responsiveness of Utility Companies to TxDOT Needs) and #38 (Number of Utilities Located in Private Easement) are related to Utility Adjustment, and drivers #4 (Right-of-

Way and Utility Scope) and #11 (Dedications of Funds to the Project) are included in the category of R/W Acquisition-related drivers.

The McNemar's test was used to identify any changes in drivers' importance by analyzing the PRE-application importance and the POST-application importance assessments of utility adjustment duration estimation according to the More Accurate estimators. Section 7.6 describes these results.

Table 7.44: Driver's POST-Application Importance Assessments of More Accurate Estimators in Non-RUDI-based Utility Adjustment Duration Estimation

Category	Driver (n=27)	Description	Mean (n=14)	Rank
U	D41	Responsiveness of Utility Companies to TxDOT Needs	0.929	1
U	D38	Number of Utilities Located in Private Easement	0.929	1
B	D4	Right-of-Way and Utility Scope	0.929	1
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.857	4
U	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.786	5
B	D18	Current Status of the R/W Project	0.786	5
B	D8	Status of Right-of-Way Map	0.786	5
U	D37	Number of Utilities Located in Public R/W	0.714	8
U	D34	Have SUE Investigations Been Performed?	0.714	8
B	D10	District R/W Annual Budget	0.714	8
B	D6	Status of Boundary Surveying	0.714	8
B	D7	Status of Environmental Clearance	0.714	12
B	D3	Project Location Type	0.714	12
B	D14	Funding Limitations for the Project	0.571	14
U	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.571	15
B	D12	LPA Funded or Non-LPA Funded	0.571	15
B	D5	Status of Schematic Design	0.571	15
B	D13	Federally Funded or Non-Federally Funded	0.500	18
B	D9	Internal R/W Staff Size of a District	0.500	18
B	D1	TxDOT Project Type	0.500	18
B	D16	Level of Political Pressure	0.429	21
B	D15	Level of Acceptance of the Project by the Public	0.429	21
B	D2	TxDOT Highway Type	0.429	23
U	D36	Utility Type	0.357	24
U	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.286	25
U	D39	Number of Utilities for Adjustments or Relocations	0.143	26
B	D17	Common Concerns of Property Owners	0.143	26

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

b. Drivers Deemed Important by Less Accurate Estimators

As described in Table 7.45, the importance levels assigned to drivers ranged from 1.0 (#41: Responsiveness of Utility Companies to TxDOT Needs and #4: Right-of-Way and Utility Scope) to 0.091 (#16: Level of Political Pressure) according to the Less

Accurate estimators. There are six drivers exceeding the cut-off point (> 0.8) in the assessments of Less Accurate estimators on the POST-application importance of drivers. Five drivers #41 (Responsiveness of Utility Companies to TxDOT Needs), #39 (Number of Utilities for Adjustments or Relocations), #36 (Utility Type), #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility), #38 (Number of Utilities Located in Private Easement) out of the six drivers are Utility Adjustment-related drivers, while the remaining one #4 (Right-of-Way and Utility Scope) is a Project Basic Facts-related driver.

Table 7.45: Driver's POST-Application Importance Assessments by Less Accurate Estimators in Non-RUDI-based Utility Adjustment Duration Estimation

Category	Driver (n=27)	Description	Mean (n=11)	Rank
U	D41	Responsiveness of Utility Companies to TxDOT Needs	1.000	1
B	D4	Right-of-Way and Utility Scope	1.000	1
U	D39	Number of Utilities for Adjustments or Relocations	0.909	3
U	D36	Utility Type	0.909	3
U	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.818	5
U	D38	Number of Utilities Located in Private Easement	0.818	5
U	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	0.727	7
B	D18	Current Status of the R/W Project	0.636	8
U	D37	Number of Utilities Located in Public R/W	0.545	9
U	D34	Have SUE Investigations Been Performed?	0.545	9
B	D17	Common Concerns of Property Owners	0.545	9
B	D9	Internal R/W Staff Size of a District	0.545	9
B	D8	Status of Right-of-Way Map	0.545	9
B	D7	Status of Environmental Clearance	0.545	9
B	D3	Project Location Type	0.545	9
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.455	16
B	D12	LPA Funded or Non-LPA Funded	0.455	17
B	D14	Funding Limitations for the Project	0.364	18
B	D2	TxDOT Highway Type	0.364	18
B	D15	Level of Acceptance of the Project by the Public	0.273	20
B	D10	District R/W Annual Budget	0.273	20
B	D5	Status of Schematic Design	0.273	20
B	D6	Status of Boundary Surveying	0.182	23
U	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	0.182	24
B	D13	Federally Funded or Non-Federally Funded	0.182	24
B	D1	TxDOT Project Type	0.182	24
B	D16	Level of Political Pressure	0.091	27

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

c. Comparative Analysis

Drivers related to Project Basic Facts and Utility Adjustment showed large differences when More Accurate and Less Accurate estimators' assessments were compared, as described in Table 7.46. One of the 15 drivers with large differences exceeding the cut-off (> 0.2) is driver #39 (Number of Utilities for Adjustment or Relocation) with a project value of "more than 7." The number of utilities required for adjustment or relocation did not influence More Accurate estimators in assessing the POST-application importance of this driver. However, this value was a significant matter in Less Accurate estimators' assessments. The difference between the two assessments for the two groups is 0.766. Ten drivers #11 (Dedication of Funds to the Project), #8 (Status of Right-of-Way Map), #10 (District R/W Annual Budget), #6 (Status of Boundary Surveying), #14 (Funding Limitations for the Project), #5 (Status of Schematic Design), #13 (Federally Funded or Non-Federally Funded), #1 (TxDOT Project Type), #16 (Level of Political Pressure), and #17 (Common Concerns of Property Owners) out of the remaining 14 drivers are Project Basic Facts-related drivers, and four #35 (Will SUE Investigations be Performed?), #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility), #36 (Utility Type), and #40 (Is There any Utility Adjustment to be Included in the Highway Construction Contract?) are related to Utility Adjustment.

Table 7.46: Comparison: POST-Application Importance of Drivers for Utility Adjustment Duration (More vs. Less Accurate Estimators in Non-RUDI-based)

Cate.	Driver (n=27)	Description	Project Value	POST-Application Importance: More Mean (n=14)	Less Mean (n=11)	Mean Difference (M-L)
U	D41	Responsiveness of Utility Companies to TxDOT Needs		0.929	1.000	– 0.071
U	D38	Number of Utilities Located in Private Easement		0.929	0.818	0.111
B	D4	Right-of-Way and Utility Scope		0.929	1.000	– 0.071
B	D11	Dedication of Funds to the Project (R/W and Construction)	Yes	0.857	0.455	0.402
U	D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	No	0.786	0.182	0.604
B	D18	Current Status of the R/W Project		0.786	0.636	0.150
B	D8	Status of Right-of-Way Map	Completed	0.786	0.545	0.241
U	D37	Number of Utilities Located in Public R/W		0.714	0.545	0.169
U	D34	Have SUE Investigations Been Performed?		0.714	0.545	0.169
B	D10	District R/W Annual Budget	Less than $6million	0.714	0.273	0.441
B	D6	Status of Boundary Surveying	Completed	0.714	0.182	0.532
B	D7	Status of Environmental Clearance		0.714	0.545	0.169
B	D3	Project Location Type		0.714	0.545	0.169
B	D14	Funding Limitations for the Project	No	0.571	0.364	0.207
U	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	Reimbursable and Non-Reimbursable	0.571	0.818	– 0.247
B	D12	LPA Funded or Non-LPA Funded		0.571	0.455	0.116
B	D5	Status of Schematic Design	Completed	0.571	0.273	0.298
B	D13	Federally Funded or Non-Federally Funded	Federally Funded	0.500	0.182	0.318
B	D9	Internal R/W Staff Size of a District		0.500	0.545	– 0.045
B	D1	TxDOT Project Type	RER	0.500	0.182	0.318
B	D16	Level of Political Pressure	Moderate	0.429	0.091	0.338
B	D15	Level of Acceptance of the Project by the Public		0.429	0.273	0.156
B	D2	TxDOT Highway Type		0.429	0.364	0.065
U	D36	Utility Type	Water, Gas, & Electric pipes	0.357	0.909	– 0.552
U	D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	No	0.286	0.727	– 0.441
U	D39	Number of Utilities for Adjustments or Relocations	More than 7	0.143	0.909	– 0.766
B	D17	Common Concerns of Property Owners	Access	0.143	0.545	– 0.402

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

Table 7.47 describes the results of the chi-square test analyzing associations between the POST-application importance of the drivers and the accuracy of utility adjustment duration estimation. The test statistics show that only eight drivers #6 (Status of Boundary Surveying), #10 (District R/W Annual Budget), #11 (Dedication of

Funds to the Project), #17 (Common Concerns of Property Owners), #35 (Will SUE Investigations be performed?), #36 (Utility Type), #39 (Number of Utilities for Adjustments or Relocations), and #40 (Is There any Utility Adjustment to be Included in the Highway Construction Contract?) out of the fifteen drivers showing large differences in the comparative analysis in the above table have statistically significant differences ($p < 0.05$). Driver #16 (Level of Political Pressure) can be considered a practically important driver even though its significance level is slightly higher than 0.05.

Moreover, all the values of gamma (G) indicate that there is a strong relationship between the accuracy of non-RUDI-based utility adjustment duration estimation of the importance of these drivers. Additionally, except for drivers #17, #36, #39 and #40, the odds ratios of the remaining drivers indicate estimators with the worst predictive accuracy of duration are more likely to consider the importance of drivers to being "Not Important" than estimators with high predictive accuracy of duration, as described in Table 7.47.

Table 7.47: Chi-square Test Results: Associations among POST-Application Importance of Project Basic Facts and Utility Adjustment-related Drivers and Accuracy of Non-RUDI-based Utility Adjustment Duration Estimation

Driver	Description	Accuracy of Estimation	Level of Importance		G	OR	Chi-Square (Sig.*P*)	Exact Test (Sig.*P*)
			Not Important	Important				
D6	Status of Boundary Surveying	Less	9	2	0.83	11.2	.008	.015
		More	4	10				
D10	District R/W Annual Budget	Less	8	3	0.74	6.6	.028	.047
		More	4	10				
D11	Dedication of Funds to the Project (R/W and Construction)	Less	6	5	0.75	7.2	.032	.081
		More	2	12				
D16	Level of Political Pressure	Less	10	1	0.76	7.5	.062	.090
		More	8	6				
D17	Common Concerns of Property Owners	Less	5	6	–0.75	0.1	.032	.081
		More	12	2				
D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	Less	9	2	0.88	16.5	.003	.005
		More	3	11				
D36	Utility Type	Less	1	10	–0.89	0.1	.005	.012
		More	9	5				
D39	Number of Utilities for Adjustments or Relocations	Less	1	10	–0.96	0.0	.001	.001
		More	12	2				
D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	Less	3	8	–0.74	0.2	.028	.047
		More	10	4				

The analyses described in this section show how estimators with different levels of duration accuracy assessed the importance of drivers once they knew drivers' values, which were the real characteristics of a delivered highway project. Based on the results, it appears that some drivers are perceived differently by More Accurate and Less Accurate estimators. However, employing these results should be limited even though their associations between duration accuracy and driver importance were statistically significant. In order to increase the reliability of the findings from this analysis, eliminating any potential project B biases related to the values of drivers should be conducted through testing additional real highway projects.

7.6 Shifts between PRE-Application and POST-Application Importance

Along with understanding relationships between the importance of drivers and duration estimation accuracy, analyzing any shifts between PRE-application and POST-application importance assessments was another necessary step to be undertaken in this study. Such shifts may have been influenced by the practitioners' knowledge of specific project values in their POST application assessments.

In order to conduct this analysis, a McNemar's test was utilized. When looking for changes in people's evaluations before and after a treatment, these kinds of statistics can be very useful. The McNemar's test compares the proportion of practitioners who changed their scores in their evaluations of PRE and POST-application durations. Therefore, 2*2 contingency tables with two related dichotomous variables are needed for this test. Even though the *p*-value from the McNemar's test is more than 0.05, which is the conventionally used level for determining significance in these kinds of tests, drivers with the *p*-value not exceeding 0.1 were considered practically important in this study. In addition, the four levels (0-not important, 1-low, 2-moderate, and 3-high) used in the PRE-application importance assessments were transformed into two levels (0-not important and 1-important) used in the POST-application importance assessments. In this transformation of data, both not important and low importance items were ranked not important, and both moderately and highly important items were deemed important.

The following sections describe how study participants with various backgrounds and different accuracy levels of duration estimation reacted to specific values of duration drivers' POST-application.

7.6.1 Analysis Using Practitioners' Backgrounds

As mentioned earlier, practitioners' backgrounds used as independent variables in this study includes "years of experience, "areas of expertise," and "types of district." The first analysis using a McNemar's test was based on "years of experience."

7.6.1.1 Years of Experience

As utilized in the analyses described earlier, the benchmark of 13 years of experience was used as the cut-off point in order to divide study participants into two groups for analysis. This number is close to the mean of all 43 estimators' years of experience.

Table 7.48 presents the results of the McNemar's test analyzing the Most Experienced estimators' perceptual changes in assessing the PRE-application and POST-application importance of the 42 duration drivers. Twelve drivers #1 (TxDOT Project Type), #2 (TxDOT Highway Type), #12 (LPA Funded or Non-LPA Funded), #13 (Federally Funded or Non-Federally Funded), #14 (Funding Limitations for the Project), #15 (Level of Acceptance of the Project by the Public), #16 (Level of Political Pressure), #17 (Common Concerns of Property Owners), #20 (Different Types of Parcel Usages), #23 (Availability of District R/W Appraisers), #27 (Are They any Property Tenants to Consider?), and #40 (Is There any Utility Adjustment to be included in the Highway Construction Contract?) described in this table have statistically or practically significant differences between the PRE-application importance assessment and the POST-application one. That is, these differences can imply that a specific value of the driver has had an effect in changing the importance of drivers. The table also shows that most of the Most Experienced practitioners changed their attitude in assessing the importance of these drivers. They considered these drivers important factors in estimating the durations of the R/W acquisition and utility adjustment before knowing the values of the drivers. However, after the values were given to the practitioners, they rated these drivers as not important.

Table 7.48: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (Most Experienced Practitioners, n=22)

Driver	Description	Value of Project B	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. p)
				Not Important	Important	
D1	TxDOT Project Type	RER	Not Important	3	1	.012
			Important	10	8	
D2	TxDOT Highway Type	FM	Not Important	5	0	.008
			Important	8	9	
D12	LPA Funded or Non-LPA Funded	LPA Funded	Not Important	2	2	.039
			Important	10	8	
D13	Federally Funded or Non-Federally Funded	Federally Funded	Not Important	2	1	.001
			Important	14	5	
D14	Funding Limitations for the Project	None	Not Important	1	2	.013
			Important	12	7	
D15	Level of Acceptance of the Project by the Public	Extensive Supportive	Not Important	4	0	.001
			Important	11	7	
D16	Level of Political Pressure	Moderate	Not Important	4	1	.006
			Important	11	6	
D17	Common Concerns of Property Owners	Access	Not Important	0	2	.007
			Important	13	7	
D20	Different Types of Parcel Usages	Residential and Commercial	Not Important	1	2	.065
			Important	9	10	
D23	Availability of District R/W Appraisers (District Staff and Outsourced)	Marginally Adequate	Not Important	1	1	.039
			Important	8	12	
D27	Are There Any Property Tenants to Consider?	No	Not Important	1	2	.065
			Important	9	10	
D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	No	Not Important	3	1	.021
			Important	9	9	

Along with analyzing the assessments of the Most Experienced practitioners, this study analyzed the Least Experienced practitioners' assessments of the PRE-application and the POST-application importance of drivers to see if and to what extent these assessments had changed. As described in Table 7.49, all drivers with a statistically significant test value had been evaluated as having importance before the practitioners viewed these drivers' values. However, after viewing the specific values of the drivers, the Least Experienced practitioners changed their scores regarding the drivers' importance. That is, the drivers were considered not important ones in estimating the durations of the R/W acquisition and utility adjustment by the Least Experienced practitioners.

Table 7.49: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (Least Experienced Practitioners, n=21)

Driver	Description	Value of Project B	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. *p*)
				Not Important	Important	
D1	TxDOT Project Type	RER	Not Important	3	1	.070
			Important	7	10	
D6	Status of Boundary Surveying	Completed	Not Important	1	2	.022
			Important	11	7	
D7	Status of Environmental Clearance	Completed	Not Important	1	0	.031
			Important	6	14	
D9	Internal R/W Staff Size of a District	Less than 9 FTEs	Not Important	4	0	.016
			Important	7	10	
D10	District R/W Annual Budget	Less than $6 million	Not Important	2	2	.065
			Important	9	8	
D15	Level of Acceptance of the Project by the Public	Extensive Supportive	Not Important	2	2	.039
			Important	10	7	
D16	Level of Political Pressure	Moderate	Not Important	4	2	.022
			Important	11	4	
D17	Common Concerns of Property Owners	Access	Not Important	1	3	.092
			Important	10	7	
D21	Frequency of Eminent Domain	Several	Not Important	2	0	.063
			Important	5	14	
D22	Source of Personnel to be used for R/W Acquisition	District Staff	Not Important	4	0	.004
			Important	9	8	
D23	Availability of District R/W Appraisers (District Staff and Outsourced)	Marginally Adequate	Not Important	3	0	.002
			Important	10	8	
D25	Type of Property Owners	Some out-of-state	Not Important	3	1	.070
			Important	7	10	
D27	Are There Any Property Tenants to Consider?	No	Not Important	1	1	.012
			Important	10	9	
D32	Likelihood of Title Curative Actions	High	Not Important	1	0	.008
			Important	8	12	
D37	Number of Utilities Located in Public R/W	4 to 7	Not Important	1	0	.063
			Important	5	15	
D39	Number of Utilities for Adjustments or Relocations	More than 7	Not Important	2	1	.070
			Important	7	11	

To sum up the differences among these practitioners based on their levels of experience, it was possible to identify common drivers showing significant changes in the importance levels in the results of the two McNemar's tests described above. According to the practitioners, the importance of these drivers fluctuated significantly when they considered these drivers' specific values. The drivers and their values are follows:

- TxDOT Project Type (D1): RER
- Level of Acceptance of the Project by the Public (D15): Extensive Supportive
- Level of Political Pressure (D16): Moderate
- Common Concerns of Property Owners (D17): Access
- Availability of District R/W Appraisers (District Staff and Outsourced) (D23): Marginally Adequate
- Are They Any Property Tenants to Consider? (D27): No

7.6.1.2 Areas of Expertise

The results of the McNemar's test analyzing the shifts between the PRE-application and the POST-application importance assessments based on practitioners' areas of expertise are described in the following two tables. As illustrated by Table 7.50, 12 drivers #1 (TxDOT Project Type), #7 (Status of Environmental Clearances), #8 (Status of Right-of-Way Map), #12 (LPA Funded or Non-LPA Funded), #13 (Federally Funded or Non-Federally Funded), #14 (Funding Limitations for the Project), #15 (Level of Acceptance of the Project by the Public), #16 (Level of Political Pressure), #17 (Common Concerns of Property Owners), #22 (Source of Personnel to be used for R/W Acquisition), #23 (Availability of District R/W Appraisers), #27 (Are They any Property Tenants to Consider?) showed a statistically significant difference in the assessment of R/W acquisition practitioners. Similar to the test results based on years of experience, these results show that the drivers were considered important in the PRE-application importance assessment, but that their importance levels were dramatically changed after combining with specific values, defined as characteristics of real highway projects.

Table 7.50: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (R/W Acquisition Practitioners, n=25)

Driver	Description	Value of Project B	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. *p*)
				Not Important	Important	
D1	TxDOT Project Type	RER	Not Important	2	1	.021
			Important	9	13	
D7	Status of Environmental Clearance	Completed	Not Important	1	0	.016
			Important	7	17	
D8	Status of Right-of-Way Map	Completed	Not Important	1	1	.070
			Important	7	16	
D12	LPA Funded or Non-LPA Funded	LPA Funded	Not Important	0	3	.021
			Important	13	9	
D13	Federally Funded or Non-Federally Funded	Federally Funded	Not Important	1	5	.064
			Important	14	5	
D14	Funding Limitations for the Project	None	Not Important	1	3	.092
			Important	10	11	
D15	Level of Acceptance of the Project by the Public	Extensive Supportive	Not Important	5	1	.012
			Important	10	9	
D16	Level of Political Pressure	Moderate	Not Important	4	1	.003
			Important	12	8	
D17	Common Concerns of Property Owners	Access	Not Important	0	3	.021
			Important	13	9	
D22	Source of Personnel to be used for R/W Acquisition	District Staff	Not Important	2	2	.022
			Important	11	10	
D23	Availability of District R/W Appraisers (District Staff and Outsourced)	Marginally Adequate	Not Important	2	0	.002
			Important	10	13	
D27	Are There Any Property Tenants to Consider?	No	Not Important	1	2	.039
			Important	10	12	

In the Utility practitioners' assessments, seven drivers #1 (TxDOT Project Type), #8 (Status of Right-of-Way Map), #13 (Federally Funded or Non-Federally Funded), #15 (Level of Acceptance of the Project by the Public), #16 (Level of Political Pressure), #17 (Common Concerns of Property Owners), #39 (Number of Utilities for Adjustments or Relocations) were identified as having a statistically significant difference between the PRE-application importance and the POST-application importance. Similar to the previous analysis described above, the Utility adjustment practitioners considered the identified drivers to be important ones before viewing the drivers' values, but after knowing the real values, they changed their perceptions of the importance of the drivers that were evaluated as important in the PRE-application importance assessments as depicted in Table 7.51.

Table 7.51: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (Utility Adjustment Practitioners, n=18)

Driver	Description	Value of Project B	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. *p*)
				Not Important	Important	
D1	TxDOT Project Type	RER	Not Important	4	1	.039
			Important	8	5	
D8	Status of Right-of-Way Map	Completed	Not Important	1	0	.063
			Important	5	12	
D13	Federally Funded or Non-Federally Funded	Federally Funded	Not Important	5	1	.070
			Important	7	5	
D15	Level of Acceptance of the Project by the Public	Extensive Supportive	Not Important	1	1	.006
			Important	11	5	
D16	Level of Political Pressure	Moderate	Not Important	4	2	.039
			Important	10	2	
D17	Common Concerns of Property Owners	Access	Not Important	1	2	.039
			Important	10	5	
D39	Number of Utilities for Adjustments or Relocations	More than 7	Not Important	2	1	.070
			Important	7	8	

7.6.1.3 Types of District

The last independent variable from the practitioners' backgrounds is types of district. As mentioned in the chapter regarding data collection, types of district can be a differentiating factor for the rating of duration drivers' importance because districts located in urban or metropolitan areas have more readily available resources than districts in rural areas do.

Twenty-eight out of the 43 study participants are practitioners working in rural districts. As described in Table 7.52, nineteen drivers showed statistical or practical significance between the PRE-application and the POST-application importance assessments. There are 10 drivers #1 (TxDOT Project Type), #2 (TxDOT Highway Type), #6 (Status of Boundary Surveying), #7 (Status of Environmental Clearances), #8 (Status of Right-of-Way Map), #10 (District R/W Annual Budget), #13 (Federally Funded or Non-Federally Funded), #14 (Funding Limitations for the Project), #15 (Level of Acceptance of the Project by the Public), and #16 (Level of Political Pressure) related to Project Basic Facts, five drivers #20 (Different Types of Parcel Usages), #21 (Frequency of Eminent Domain), #22 (Source of Personnel to be used for R/W Acquisition), #23 (Availability of District R/W Appraisers), and #27 (Are There any Property Tenants to Consider?) related to R/W Acquisition, and four drivers #35 (Will SUE Investigations be performed?), #36 (Utility Type), #37 (Number of Utilities Located in Public R/W), and #39 (Number of Utilities for Adjustments or Relocations) related to Utility Adjustment.

Table 7.52: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (Rural District Practitioners, n=28)

Driver	Description	Value of Driver	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. *p*)
				Not Important	Important	
D1	TxDOT Project Type	RER	Not Important	4	2	.013
			Important	12	10	
D2	TxDOT Highway Type	FM	Not Important	6	2	.022
			Important	11	9	
D6	Status of Boundary Surveying	Completed	Not Important	4	1	.039
			Important	8	15	
D7	Status of Environmental Clearance	Completed	Not Important	3	0	.063
			Important	5	20	
D8	Status of Right-of-Way Map	Completed	Not Important	2	1	.070
			Important	7	18	
D10	District R/W Annual Budget	Less than $6 million	Not Important	3	3	.092
			Important	10	12	
D13	Federally Funded or Non-Federally Funded	Federally Funded	Not Important	6	5	.096
			Important	13	4	
D14	Funding Limitations for the Project	None	Not Important	4	3	.035
			Important	12	9	
D15	Level of Acceptance of the Project by the Public	Extensive Supportive	Not Important	6	1	.006
			Important	11	10	
D16	Level of Political Pressure	Moderate	Not Important	5	3	.035
			Important	12	8	
D20	Different Types of Parcel Usages	Residential and Commercial	Not Important	2	2	.022
			Important	11	13	
D21	Frequency of Eminent Domain	Several	Not Important	2	0	.008
			Important	8	18	
D22	Source of Personnel to be used for R/W Acquisition	District Staff	Not Important	2	3	.057
			Important	11	12	
D23	Availability of District R/W Appraisers (District Staff and Outsourced)	Marginally Adequate	Not Important	2	1	.003
			Important	12	13	
D27	Are There Any Property Tenants to Consider?	No	Not Important	1	3	.092
			Important	10	14	
D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	Yes	Not Important	8	2	.039
			Important	10	8	
D36	Utility Type	Water, Underground/Overhead Communication, Gas, and Electric pipes	Not Important	2	0	.031
			Important	6	20	
D37	Number of Utilities Located in Public R/W	4 to 7	Not Important	1	1	.070
			Important	7	19	
D39	Number of Utilities for Adjustments or Relocations	More than 7	Not Important	1	0	.063
			Important	5	22	

In the assessments of the Urban / Metropolitan district practitioners, nine drivers #1 (TxDOT Project Type), #13 (Federally Funded or Non-Federally Funded), #15 (Level of Acceptance of the Project by the Public), #16 (Level of Political Pressure), #22

(Source of Personnel to be used for R/W Acquisition), #23 (Availability of District R/W Appraisers), #25 (Type of Property Owners), #27 (Are There Any Property Tenants to Consider?), and #39 (Number of Utilities for Adjustments or Relocations) were identified as having statistically significant differences as illustrated in Table 7.53. Similar to the previous McNemar's test results, the change pattern in importance was from "important" to "not important."

Table 7.53: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (Urban / Metropolitan District Practitioners, n=15)

Driver	Description	Value of Project B	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. *p*)
				Not Important	Important	
D1	TxDOT Project Type	RER	Not Important	2	0	.063
			Important	5	8	
D13	Federally Funded or Non-Federally Funded	Federally Funded	Not Important	0	1	.039
			Important	8	6	
D15	Level of Acceptance of the Project by the Public	Extensive Supportive	Not Important	0	1	.012
			Important	10	4	
D16	Level of Political Pressure	Moderate	Not Important	3	0	.002
			Important	10	2	
D22	Source of Personnel to be used for R/W Acquisition	District Staff	Not Important	3	0	.016
			Important	7	5	
D23	Availability of District R/W Appraisers (District Staff and Outsourced)	Marginally Adequate	Not Important	2	0	.031
			Important	6	7	
D25	Type of Property Owners	Some out-of-state	Not Important	3	0	.063
			Important	5	7	
D27	Are There Any Property Tenants to Consider?	No	Not Important	1	0	.004
			Important	9	5	
D39	Number of Utilities for Adjustments or Relocations	More than 7	Not Important	1	1	.021
			Important	9	4	

Using the practitioners' backgrounds as independent variables, the analysis of the impacts of project values on the drivers' importance showed that some knowledge of the drivers' values can influence practitioners' perceptions of the drivers' importance when practitioners predict durations for R/W acquisition and utility adjustment.

7.6.2 Analysis Using Duration Estimation Accuracy

7.6.2.1 Accuracy of R/W Acquisition Duration

Based on the determination of duration accuracy described earlier, the McNemar's test was conducted to analyze More Accurate estimators' perceptual changes in assessing the importance of duration drivers. Since for the purposes of this study, the researcher assumed that Project Basic Facts-related and R/W Acquisition-related drivers are the only ones considered in forecasting the durations of the R/W acquisition process in a highway project, this analysis focused on the drivers related to these two categories.

As described in Table 7.54, there are six duration drivers showing differences between the PRE-application importance and the POST-application importance assessments. Five drivers #8 (Status of Right-of-Way Map), #12 (LPA Funded or Non-LPA Funded), #15 (Level of Acceptance of the Project by the Public), #16 (Level of Political Pressure), and #17 (Common Concerns of Property Owners) out of them are related to Project Basic Facts, and the remaining driver, #27 (Are There Any Property Tenants to Consider?), is among the R/W Acquisition-related drivers.

Although these drivers described in Table 7.54 showed significant shifts between the PRE-application and POST-application importance assessments of More Accurate estimators in R/W acquisition duration, it is necessary to test other values of drivers in order to improve the reliability of the results. That is, because the values of project B were not representative of all characteristics of all highway projects, accurately measuring the impact of drivers' values on the POST-application importance levels demands additional sample data.

Table 7.54: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (More Accurate Estimators in Non-RUDI-based R/W Acquisition Duration, n=14)

Driver	Description	Value of Project B	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. *p*)
				Not Important	Important	
D8	Status of Right-of-Way Map	Completed	Not Important	1	0	.031
			Important	6	7	
D12	LPA Funded or Non-LPA Funded	LPA Funded	Not Important	2	1	.070
			Important	7	4	
D15	Level of Acceptance of the Project by the Public	Extensive Supportive	Not Important	2	1	.070
			Important	7	4	
D16	Level of Political Pressure	Moderate	Not Important	2	0	.008
			Important	8	4	
D17	Common Concerns of Property Owners	Access	Not Important	0	1	.021
			Important	9	4	
D27	Are There Any Property Tenants to Consider?	No	Not Important	1	1	.039
			Important	8	4	

Table 7.55 describes the results of the McNemar's test showing nine drivers with practically or statistically significant differences according to the assessments of Less Accurate estimators in R/W acquisition duration. Drivers #21 (Frequency of Eminent Domain) and #31 (Level of Local Availability of Replacement Business Facilities) proved to be statistically significant because their *p*-values are less than 0.05. Conversely, the remaining seven drivers #9 (Internal R/W Staff Size of a District), #10 (District R/W Annual Budget), #13 (Federally Funded or Non-Federally Funded), #22 (Source of Personnel to be used for R/W Acquisition), #23 (Availability of District R/W Appraisers), #26 (Level of Familiarity with Key Landowners), #29 (Level of Local Availability of Replacement Housing Facilities) did not show a statistical significance,

but they can be considered to be practically important based on their relatively low significance values.

As illustrated in Table 7.55, there are no drivers included in this list of drivers shared in common with that of the More Accurate estimators. In other words, Less Accurate estimators in R/W acquisition duration showed different perceptions compared to More Accurate estimators when evaluating the importance of duration drivers.

Table 7.55: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (Less Accurate Estimators in Non-RUDI-based R/W Acquisition Duration, n=12)

Driver	Description	Value of Project B	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. *p*)
				Not Important	Important	
D9	Internal R/W Staff Size of a District	Less than 9 FTEs	Not Important	2	0	.063
			Important	5	5	
D10	District R/W Annual Budget	Less than $6 million	Not Important	2	0	.063
			Important	5	5	
D13	Federally Funded or Non-Federally Funded	Federally Funded	Not Important	2	1	.070
			Important	7	2	
D21	Frequency of Eminent Domain	Several	Not Important	1	0	.008
			Important	8	3	
D22	Source of Personnel to be used for R/W Acquisition	District Staff	Not Important	2	0	.063
			Important	5	5	
D23	Availability of District R/W Appraisers (District Staff and Outsourced)	Marginally Adequate	Not Important	1	0	.063
			Important	5	6	
D26	Level of Familiarity with Key Landowners	High	Not Important	4	0	.063
			Important	5	3	
D29	Level of Local Availability of Replacement Housing Facilities	Low	Not Important	2	5	.063
			Important	0	5	
D31	Level of Local Availability of Replacement Business Facilities	Low	Not Important	2	0	.004
			Important	9	1	

7.6.2.2 Accuracy of Utility Adjustment Duration

Fourteen practitioners with better accuracy in estimating utility adjustment durations changed their evaluation scores for the drivers described in Table 7.56. Among the drivers, driver #34 (Have SUE Investigations been Performed?) was evaluated as having no importance in the PRE-application importance, but the More Accurate estimators adjusted the importance of the driver after viewing its value. This means that More Accurate estimators recognize this driver as an important one when it is not completed changing their evaluation once they learn more about it.

Table 7.56: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (More Accurate Estimators in Non-RUDI-based Utility Adjustment Duration, n=14)

Driver	Description	Value of Project B	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. *p*)
				Not Important	Important	
D17	Common Concerns of Property Owners	Access	Not Important	0	1	.003
			Important	12	1	
D34	Have SUE Investigations Been Performed?	No	Not Important	3	7	.070
			Important	1	3	
D36	Utility Type	Water, Underground/ Overhead Communication, Gas, and Electric pipes	Not Important	1	0	.008
			Important	8	5	
D39	Number of Utilities for Adjustments or Relocations	More than 7	Not Important	1	0	.001
			Important	11	2	
D40	Is there any Utility Adjustment to be Included in the Highway Construction Contract?	No	Not Important	2	1	.039
			Important	8	3	

There are six duration drivers #1 (TxDOT Project Type), #5 (Status of Schematic Design), #10 (District R/W Annual Budget), #13 (Federally Funded or Non-Federally Funded), #15 (Level of Acceptance of the Project by the Public), #35 (Will SUE Investigations Be Performed?) with significant differences in the assessments of Less

Accurate estimators as described in Table 7.57. None of these drivers are included in the list of drivers of the More Accurate estimators' assessments above. This result implies that experts with different accuracy levels in utility adjustment duration estimation perceive the importance of some drivers differently. However, in order to identify additional key drivers, it is more critical to understand how practitioners with better predictive accuracy consider duration drivers affecting the durations of these pre-construction processes when compared to practitioners with poor accuracy levels.

Table 7.57: McNemar's Test Results: Differences between PRE-Application and POST-Application Importance of Drivers (Less Accurate Estimators in Non-RUDI-based Utility Adjustment Duration, n=11)

Driver	Description	Value of Driver	PRE-Application Importance	POST-Application Importance		McNemar Test (Sig. *p*)
				Not Important	Important	
D1	TxDOT Project Type	RER	Not Important	4	0	.063
			Important	5	2	
D5	Status of Schematic Design	Completed	Not Important	1	1	.070
			Important	7	2	
D10	District R/W Annual Budget	Less than $6 million	Not Important	1	1	.070
			Important	7	2	
D13	Federally Funded or Non-Federally Funded	Federally Funded	Not Important	2	1	.070
			Important	7	1	
D15	Level of Acceptance of the Project by the Public	Extensive Supportive	Not Important	1	0	.016
			Important	7	3	
D35	Will SUE Investigations Be Performed? (If no or unknown in the duration driver # 34)	Yes	Not Important	1	0	.008
			Important	8	2	

Although only one highway project was used to test the possible impacts of specific driver value on the evaluation of driver importance, there were significant changes in the practitioners' perceptions of the importance of drivers before and after practitioners knew them. This finding can be useful in identifying the real values that cause drivers to have significant impact on the durations of the R/W acquisition and utility adjustment processes in a highway project.

7.7 INFLUENTIAL DURATION DRIVERS

This section summarizes a list of drivers that should be added to RUDI in order to improve its accuracy. Although the RUDI tool has shown better performance in predicting the durations of R/W acquisition and utility adjustment when compared to the estimation based on practitioners' personal judgments alone, additional needs exist to capture more data points that can be considered in making the estimations.

In order to identify drivers that can be used as additional key data points for RUDI, the PRE-application importance of More Accurate and Less Accurate estimators was compared to each other. Then the drivers showing large differences (> 0.2) were separated from the 42 drivers. In addition, the drivers evaluated as having relatively high importance (> 0.8) by both More and Less Accurate estimators were selected. As frequently mentioned in the previous chapters, 18 drivers related to Project Basic Facts and 15 related to R/W Acquisition were deemed to be those that affect the durations of R/W acquisition. Along with the 18 Project Basic Facts-related drivers, nine drivers related to Utility Adjustment were selected as factors affecting the utility adjustment duration estimation.

7.7.1 Influential Drivers for R/W Acquisition Duration

As described in Table 7.58, 13 drivers, consisting of eight Project Basic Facts-related and five R/W Acquisition-related drivers, were identified as additional data points for the R/W acquisition part of RUDI. The criteria for identifying these influential drivers were that whether the PRE-application importance of driver showed large differences (> 0.2) between More Accurate and Less Accurate estimators or the importance was evaluated as having high importance (> 0.8) by both More and Less Accurate estimators in the non-RUDI-based R/W acquisition duration estimation.

Except for drivers #10 (District R/W Annual Budget), #4 (Right-of-Way and Utility Scope), and #8 (Status of Right-of-Way Map), the remaining ten drivers were evaluated as having high importance by More Accurate estimators as compared to the rankings of Less Accurate estimators. In addition, drivers #1 (TxDOT Project Type), #10 (District R/W Annual Budget), and #19 (Number of Parcels for Acquisition) were already utilized as data points in RUD. Specifically, RUDI already included driver #1 as one of the key factors in estimating the durations of the utility adjustment, while drivers #10 and #19 were already used for the R/W acquisition duration estimation. This finding may end up proving that these three drivers are considerably significant in predicting the durations of both R/W acquisition and utility adjustment.

Table 7.58: Most Influential Drivers Required in Predicting R/W Acquisition Duration

Cat.	Driver	Description	Original Pool		
			PRE-Application		Difference (M-L)
			MORE Accurate (n=14)	LESS Accurate (n=12)	
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.929	0.500	0.429
R	D29	Level of Local Availability of Replacement Housing Facilities	0.905	0.528	0.377
R	D28	Need for Residential Relocation	0.929	0.583	0.346
B	D14	Funding Limitations for the Project	0.952	0.611	0.341
R	D32	Likelihood of Title Curative Actions	0.905	0.639	0.266
B	D1	TxDOT Project Type	0.857	0.611	0.246
B	D10	District R/W Annual Budget	0.595	0.833	– 0.238
B	D16	Level of Political Pressure	0.643	0.417	0.226
R	D21	Frecuency of Eminent Domain	0.929	0.806	0.123
B	D7	Status of Environmental Clearance	0.929	0.833	0.096
R	D19	Number of Parcels for Acquisition	0.857	0.806	0.051
B	D4	Right-of-Way and Utility Scope	0.810	0.861	– 0.051
B	D8	Status of Right-of-Way Map	0.857	0.889	– 0.032

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

The PRE-application importance of these 13 drivers was retested after specific values were given to each driver and then any changes in importance were analyzed by comparing these two types of importance assessments, PRE and POST-application. This evaluation revealed that some experts had changed their scoring of the importance of drivers after knowing the specific values given to each driver as Table 7.59 illustrates. More specifically, except for drivers #10 (District R/W Annual Budget), #19 (Number of Parcels for Acquisition), and #21 (Frequency of Eminent Domain), the importance of the remaining 10 drivers decreased. More Accurate estimators changed their assessments of the importance of drivers #14 (Funding Limitations for the Project), #16 (Level of Political Pressure), and #28 (Need for Residential Relocation) when “No,” “Moderate,” and “Substantial” had been assigned to the drivers as values, respectively. In addition, the importance of drivers #8 (Status of Right-of-Way Map) and #7 (Status of Environmental Clearance) were significantly reduced when “Completed” had been given to the drivers as values. That is, if these preliminary design-related activities were completed during the planning phase, they were not considered to be critical issues in forecasting durations for R/W acquisition.

Conversely, More Accurate estimators considered driver #10 to be more important when they learned the R/W annual budget of the district was less than $6 million. That is, for More Accurate estimators, the size of the district R/W annual budget could be critical in their decision-making about the durations of the R/W acquisition process. However, drivers #19 and #21 were evaluated as having relatively high importance in both the PRE- and POST-application assessments.

Table 7.59: Change in Driver Importance: More Accurate Estimators in Non-RUDI-based R/W Acquisition Duration Estimation

Cat.	Driver	Description	Project Value	R/W Acquisition			
				MORE Accurate (n=14)		Difference (POST-PRE)	Change in Driver Importance
				PRE-Application	POST-Application		
B	D14	Funding Limitations for the Project	No	0.952	0.500	– 0.452	Decrease
B	D16	Level of Political Pressure	Moderate	0.643	0.286	– 0.357	Decrease
B	D8	Status of Right-of-Way Map	Completed	0.857	0.500	– 0.357	Decrease
B	D7	Status of Environmental Clearance	Completed	0.929	0.643	– 0.286	Decrease
R	D28	Need for Residential Relocation	Substantial	0.929	0.714	– 0.215	Decrease
R	D29	Level of Local Availability of Replacement Housing Facilities	Low	0.905	0.714	– 0.191	Decrease
B	D11	Dedication of Funds to the Project (R/W and Construction)	Yes	0.929	0.786	– 0.143	Decrease
B	D1	TxDOT Project Type	RER	0.857	0.714	– 0.143	Decrease
B	D10	District R/W Annual Budget	Less than $6M	0.595	0.714	0.119	Increase
B	D4	Right-of-Way and Utility Scope	Both	0.810	0.714	– 0.096	Decrease
R	D19	Number of Parcels for Acquisition	> 30	0.857	0.929	0.072	Increase
R	D21	Frequency of Eminent Domain	Several	0.929	1.000	0.071	Increase
R	D32	Likelihood of Title Curative Actions	High	0.905	0.857	– 0.048	Decrease

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

7.7.2 Influential Drivers for Utility Adjustment Duration

For utility adjustment, there were four drivers (#34, #14, #42, and #11) with large differences (> 0.2) between More Accurate and Less Accurate estimators' assessments, and five drivers (#8, #7, #4, #38, and #41) showing relatively high importance (> 0.8) in both assessments. As described in Table 7.60, two drivers #34 (Have SUE Investigations been Performed?) and #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility) out of four drivers were evaluated as having a relatively low importance by More Accurate estimators as compared to Less Accurate estimators. For drivers #14 (Funding Limitations for the Project) and #11 (Dedication of Funds to the Project), Less Accurate estimators did not rate them to be as important as More Accurate estimators did. The remaining five drivers were evaluated as having high importance (>

0.8) by both More and Less Accurate estimators in the non-RUDI-based utility adjustment duration estimation.

Table 7.60: Most Influential Drivers Required in Predicting Utility Adjustment Duration

Cat.	Driver	Description	Original Pool		
			PRE-Application		Difference (M-L)
			MORE Accurate (n=14)	LESS Accurate (n=11)	
U	D34	Have SUE Investigations Been Performed?	0.476	0.879	– 0.403
B	D14	Funding Limitations for the Project	0.929	0.576	0.353
U	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.619	0.939	– 0.320
B	D11	Dedication of Funds to the Project (R/W and Construction)	0.833	0.576	0.257
B	D8	Status of Right-of-Way Map	0.952	0.818	0.134
B	D7	Status of Environmental Clearance	0.929	0.848	0.081
B	D4	Right-of-Way and Utility Scope	0.833	0.879	– 0.046
U	D38	Number of Utilities Located in Private Easement	0.857	0.879	– 0.022
U	D41	Responsiveness of Utility Companies to TxDOT Needs	0.905	0.909	– 0.004

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

The descriptive statistic method was used in testing the differences between the PRE-application and the POST-application importance of the influential drivers for utility adjustment. The same approach utilized for the influential drivers for R/W acquisition duration was used to see if the specific values of these drivers had influenced the importance level according to the practitioners. As described in Table 7.61, drivers #14 (Funding Limitations for the Project), #34 (Have SUE Investigations been Performed?), and #7 (Status of Environmental Clearance) showed large differences (> 0.2), while the remaining six drivers did not provide significant differences between the PRE- and POST-application importance assessments of More Accurate estimators. Specifically, the PRE- and POST-application importance of drivers #4 (Right-of-Way and Utility Scope), #38 (Number of Utilities Located in Private Easement), #11 (Dedication of Funds to the Project), and #41 (Responsiveness of Utility Companies to TxDOT Needs) were more than 0.8 as described in Table 7.61.

Table 7.61: Change in Driver Importance: More Accurate Estimators in Non-RUDI-based Utility Adjustment Duration Estimation

Cat.	Driver	Description	Project Value	Utility Adjustment			
				MORE Accurate (n=14)		Difference (POST-PRE)	Change in Driver Importance
				PRE-Application	POST-Application		
B	D14	Funding Limitations for the Project	No	0.929	0.571	– 0.358	Decrease
U	D34	Have SUE Investigations Been Performed?	Yes	0.476	0.714	0.238	Increase
R	D7	Status of Environmental Clearance	Completed	0.929	0.714	– 0.215	Decrease
B	D8	Status of Right-of-Way Map	Completed	0.952	0.786	– 0.166	Decrease
B	D4	Right-of-Way and Utility Scope	Both	0.833	0.929	0.096	Increase
U	D38	Number of Utilities Located in Private Easement	4 to 7	0.857	0.929	0.072	Increase
U	D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	Both	0.619	0.571	– 0.048	Decrease
B	D11	Dedication of Funds to the Project (R/W and Construction)	Yes	0.833	0.857	– 0.024	Decrease
U	D41	Responsiveness of Utility Companies to TxDOT Needs	High	0.905	0.929	0.024	Increase

* B: Project Basic Facts-related, R: R/W Acquisition-related, and U: Utility Adjustment-related

The drivers described as influential drivers in this section for R/W acquisition and utility adjustment either showed large perceptual differences between More and Less Accurate estimators in practitioners' estimates of the PRE-application importance or were evaluated as having high importance (> 0.8) by both kinds of estimators. Based on this result, including these drivers may be one of the improvements that should be made for the RUDI tool, although the findings described need to be retested to increase their reliability.

Chapter 8: Validation of Findings

This chapter describes the results of validation of this study's findings. Specifically, the duration drivers deemed to be influential, those with large differences among experts' assessments of their PRE-application importance, were retested to see if the same results were obtained using new validation sample data.

8.1 Analysis for Validation

As described in Chapter 7, one of the main findings from this study included the identification of drivers that showed significant differences and high importance in terms of perceptions among practitioners in assessing the PRE-application importance of drivers when predicting the durations of the R/W acquisition and utility adjustment processes. These drivers can be used as additional key information to be added to the RUDI tool for enhancing the accuracy of duration estimation because More Accurate estimators presented different perceptions of the importance of these drivers as compared to Less Accurate estimators. Adding the information about the More Accurate estimators could help make the RUDI tool more effective in future applications.

For the purposes of validation, a validation pool was constituted using additional data collection of two model projects that were selected for this study. As described in Chapter 5, three highway projects (A, B, and C) were selected from ROWIS in the preparation phase of this study. However, only project B was utilized for the major data collection because that project was the only one successfully delivered on schedule. The remaining two projects were delayed or terminated due to a lack of funding for utility and construction after the completion of the R/W acquisition process. Therefore, these two projects have collected data that are only related to the R/W acquisition process. Twelve practitioners each participated in analyzing RUDI on projects A and C, respectively. In addition, new eight respondents examined project B. In summary, for validating the drivers for R/W acquisition, 32 new participants were studied, consisting of 12 for project A, 8 for project B, and 12 for project C. Eight respondents examining project B only were available to validate the assessment of drivers regarding the utility adjustment process because, as mentioned above, the utility adjustment process did not progress that far for projects A and C.

Among these three projects, projects A and C include different characteristics, although not significant ones, as compared to project B that was used as the main source for data collection and analysis in this study. The following two tables describe the assessment results of the PRE- and POST-application importance of drivers related only to Project Basic Facts and R/W Acquisition on project A and C.

As described in Table 8.1, except for drivers #6 (Status of Boundary Surveying), #7 (Status of Environmental Clearance), #19 (Number of Parcels for Acquisition), and #20 (Different Types of Parcel Usages), the remaining drivers were evaluated as having relatively high PRE-application importance as compared to their POST-application importance. Moreover, 22 out of the total 33 drivers showed large differences (> 0.2) between the PRE-application and the POST-application importance assessments. Even though the real values of these 22 drivers may have caused significant differences, the extremely small size of the sample data may have also influenced the results. This pattern appeared in the importance assessment results of project C. These details are illustrated in Table 8.2.

Table 8.1: Comparison: PRE-Application and Post-Application Importance of Drivers-related to Project Basic Facts and R/W Acquisition on Project A

Cat.	Driver	Description	Mean (n=12)		Difference (Pre-Post)	Project Value
			PRE	POST		
Project Basic Facts	D1	TxDOT Project Type	0.750	0.500	0.250	WF
	D2	TxDOT Highway Type	0.778	0.583	0.194	
	D3	Project Location Type	0.806	0.500	0.306	Metropolitan
	D4	Right-of-Way and Utility Scope	0.722	0.667	0.056	
	D5	Status of Schematic Design	0.722	0.583	0.139	
	D6	Status of Boundary Surveying	0.639	0.667	– 0.028	
	D7	Status of Environmental Clearance	0.806	0.917	– 0.111	
	D8	Status of Right-of-Way Map	0.944	0.917	0.028	
	D9	Internal R/W Staff Size of a District	0.750	0.250	0.500	9 or more than 9 FTEs
	D10	District R/W Annual Budget	0.694	0.167	0.528	More than $6 million
	D11	Dedication of Funds to the Project (R/W & Construction)	0.778	0.167	0.611	Yes
	D12	LPA Funded or Non-LPA Funded	0.750	0.083	0.667	Non-LPA funded
	D13	Federally Funded or Non-Federally Funded	0.750	0.167	0.583	Federally funded
	D14	Funding Limitations for the Project	0.806	0.083	0.722	None
	D15	Level of Acceptance of the Project by the Public	0.611	0.083	0.528	Extensive Supportive
	D16	Level of Political Pressure	0.861	0.333	0.528	Extensive
	D17	Common Concerns of Property Owners	0.750	0.250	0.500	Access & Project Duration
	D18	Current Status of the R/W Project	0.806	0.750	0.056	
R/W Acquisition	D19	Number of Parcels for Acquisition	0.833	1.000	– 0.167	
	D20	Different Types of Parcel Usages	0.778	0.833	– 0.056	
	D21	Frequency of Eminent Domain	0.889	0.833	0.056	
	D22	Source of Personnel to be used for R/W Acquisition	0.611	0.167	0.444	Unknown
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.833	0.417	0.417	Adequate
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.639	0.333	0.306	Yes
	D25	Type of Property Owners	0.528	0.000	0.528	Some out-of-state
	D26	Level of Familiarity with Key Landowners	0.611	0.000	0.611	Low
	D27	Are There Any Property Tenants to Consider?	0.750	0.250	0.500	No
	D28	Need for Residential Relocation	0.861	0.750	0.111	
	D29	Level of Local Availability of Replacement Housing Facilities	0.806	0.417	0.389	High
	D30	Need for Business Relocation	0.833	0.583	0.250	Substantial
	D31	Level of Local Availability of Replacement Business Facilities	0.861	0.500	0.361	High
	D32	Likelihood of Title Curative Actions	0.833	0.333	0.500	High
	D33	Responsiveness of Local Title Companies to TxDOT	0.778	0.500	0.278	High

Except for two drivers #6 (Status of Boundary Surveying) and #21 (Frequency of Eminent Domain), the remaining 31 drivers' PRE-application importance ratings were significantly or slightly higher than the POST-application importance, as described in

Table 8.2. As mentioned above, a lack of sample data and the real values of drivers may have caused these large differences (> 0.2) between different importance assessments of project C.

Table 8.2: Comparison: PRE-Application and Post-Application Importance of Drivers-related to Project Basic Facts and R/W Acquisition on Project C

Cat.	Driver	Description	Mean (n=12)		Difference (Pre-Post)	Project Value
			PRE	POST		
Project Basic Facts	D1	TxDOT Project Type	0.833	0.333	0.500	UGN
	D2	TxDOT Highway Type	0.806	0.250	0.556	US
	D3	Project Location Type	0.806	0.417	0.389	Rural
	D4	Right-of-Way and Utility Scope	0.861	0.500	0.361	R/W and Utility
	D5	Status of Schematic Design	0.694	0.583	0.111	
	D6	Status of Boundary Surveying	0.611	0.750	– 0.139	
	D7	Status of Environmental Clearance	0.889	0.833	0.056	
	D8	Status of Right of Way Map	0.833	0.500	0.333	Not started
	D9	Internal R/W Staff Size of a District	0.639	0.333	0.306	Less than 9 FTEs
	D10	District R/W Annual Budget	0.611	0.167	0.444	Less than $6 million
	D11	Dedication of Funds to the Project (R/W and Construction)	0.806	0.250	0.556	No
	D12	LPA Funded or Non-LPA Funded	0.750	0.250	0.500	LPA funded
	D13	Federally Funded or Non-Federally Funded	0.861	0.167	0.694	Federally funded
	D14	Funding Limitations for the Project	0.750	0.250	0.500	None
	D15	Level of Acceptance of the Project by the Public	0.750	0.250	0.500	Mixed
	D16	Level of Political Pressure	0.694	0.167	0.528	Minimal
	D17	Common Concerns of Property Owners	0.778	0.333	0.444	Project Duration
	D18	Current Status of the R/W Project	0.778	0.583	0.194	
R/W Acquisition	D19	Number of Parcels for Acquisition	0.917	0.917	0.000	
	D20	Different Types of Parcel Usages	0.833	0.750	0.083	
	D21	Frequency of Eminent Domain	0.889	0.917	– 0.028	
	D22	Source of Personnel to be used for R/W Acquisition	0.694	0.333	0.361	Outsourced
	D23	Availability of District R/W Appraisers (District Staff and Outsourced)	0.667	0.333	0.333	Adequate
	D24	Is Funding Available for Outsourcing Staff Assistance?	0.750	0.417	0.333	Yes
	D25	Type of Property Owners	0.750	0.167	0.583	Unknown
	D26	Level of Familiarity with Key Landowners	0.639	0.000	0.639	Low
	D27	Are There Any Property Tenants to Consider?	0.778	0.333	0.444	No
	D28	Need for Residential Relocation	0.861	0.667	0.194	
	D29	Level of Local Availability of Replacement Housing Facilities	0.722	0.333	0.389	Low
	D30	Need for Business Relocation	0.833	0.333	0.500	None
	D31	Level of Local Availability of Replacement Business Facilities	0.833	0.083	0.750	Unknown
	D32	Likelihood of Title Curative Actions	0.806	0.083	0.722	Unknown
	D33	Responsiveness of Local Title Companies to TxDOT	0.889	0.417	0.472	Unknown

After the validation pool was constructed, data including the duration estimation and the importance of drivers were analyzed on the basis of the same approaches outlined in Chapter 7. The validation results are described in Section 8.2 in detail.

8.2 VALIDATION RESULTS

8.2.1 Drivers for R/W Acquisition Duration Estimation

Table 8.3 describes the validation results involving the influential drivers showing high importance ratings or large differences between More Accurate and Less Accurate estimators in predicting the durations of the R/W acquisition process of project B. In the validation pool, nine and eight practitioners, respectively, were grouped into the More Accurate and Less Accurate groups. These estimators showed different perceptions of the identified influential drivers, showing large differences from the data analysis of this study. Specifically, driver #10 (District R/W Annual Budget) was evaluated as not having high importance according to the assessments of More Accurate estimators in the validation pool. Conversely, Less Accurate estimators considered this driver to be an important one in predicting the duration of R/W acquisition. These differences mean that there is a significant perceptual difference among practitioners with different levels of duration accuracy in assessing the importance of the size of a district's R/W annual budget. However, More and Less Accurate estimator did not show large differences in assessing the PRE-application importance of driver #4 (Right-of-Way and Utility Scope) even though small change in importance occurred. For the remaining drivers, More Accurate estimators assigned relatively high levels of importance to them as compared to Less Accurate estimators. Finally, the direction of change in importance of driver #8

(Status of Right-of-Way Map) was not validated in the validation analysis as described in Table 8.3.

Table 8.3: Validation Results: Most Influential Drivers for R/W Acquisition

Driver	Description	Original Pool			Validation Pool		
		PRE-Application		Diff. (M-L)	PRE-Application		Diff. (M-L)
		MORE Accurate (n=14)	LESS Accurate (n=12)		MORE Accurate (n=9)	LESS Accurate (n=8)	
D11	Dedication of Funds to the Project (R/W and Construction)	0.929	0.500	0.429	0.852	0.625	0.227
D29	Level of Local Availability of Replacement Housing Facilities	0.905	0.528	0.377	0.852	0.583	0.269
D28	Need for Residential Relocation	0.929	0.583	0.346	0.963	0.667	0.296
D14	Funding Limitations for the Project	0.952	0.611	0.341	0.815	0.500	0.315
D32	Likelihood of Title Curative Actions	0.905	0.639	0.266	0.852	0.542	0.310
D1	TxDOT Project Type	0.857	0.611	0.246	0.815	0.542	0.273
D10	District R/W Annual Budget	0.595	0.833	– 0.238	0.296	0.667	– 0.371
D16	Level of Political Pressure	0.643	0.417	0.226	0.667	0.458	0.209
D21	Frequency of Eminent Domain	0.929	0.806	0.123	1.000	0.750	0.250
D7	Status of Environmental Clearance	0.929	0.833	0.096	0.963	0.708	0.255
D19	Number of Parcels for Acquisition	0.857	0.806	0.051	1.000	0.750	0.250
D4	Right-of-Way and Utility Scope	0.810	0.861	– 0.051	0.815	0.833	– 0.018
D8	Status of Right-of-Way Map	0.857	0.889	– 0.032	0.926	0.792	0.134

Another key observation in this study is the ways that influential drivers can be differently perceived by practitioners with better predictive accuracy after specific values were given to these drivers. After discarding drivers with different values in the validation pool for validation, the remaining drivers #14 (Funding Limitations for the Project), #16 (Level of Political Pressure), #28 (Need for Residential Relocation), #29 (Level of Local Availability of Replacement Housing Facilities), and #11 (Dedication of Funds to the Project) were retested using the validation pool because these drivers that were assigned same values. The validation results showed that More Accurate estimators changed their scores in assessing the importance of the influential drivers after viewing the specific values of drivers.

Specifically, the importance of driver #14 (Funding Limitations for the Project) decreased if there were not any funding problems for the project. For driver #16 (Level of Political Pressure), if political pressure on the project was moderate, this driver was not considered to be an issue in forecasting the durations of the R/W acquisition process by More Accurate estimators. The importance of driver #28 (Need for Residential Relocation) decreased even though highway projects had many residential properties that required relocation. This observation means that whatever values are given to this driver, practitioners may consider this to be one of the important factors in the R/W acquisition duration estimation. This pattern may have been caused by the fact that that most of recently delivered highway projects in TxDOT required a substantial need for residential relocation. In other words, a substantial need for relocating residential facilities is very common when acquiring properties. The value of the driver "Level of Local Availability of Replacement Housing Facilities" was "Low." The validation result showed the same pattern as model project B. However, the amount of change in importance was relatively large (-0.519) compared to the difference (-0.191) in project B because only nine practitioners were investigated for the validation analysis. The small sample size may have caused this difference. For driver #11 (Dedication of Funds to the Project), the change in importance was successfully validated, as described in Table 8.4. However, while the POST-application importance of this driver was still relatively high (0.786), nine More Accurate estimators in the validation pool showed large differences between the PRE-application and the POST-application importance. As mentioned earlier, this may have been caused by the limited sample size. Finally, the remaining three drivers were not retested for validation because the project constituting the validation pool did not have the same values for these drivers.

Table 8.4: Validation Results: Change in Importance of the Influential Drivers for R/W Acquisition Duration

Driver	Description	Value of Project B	Original Pool			Validation Pool		
			MORE Accurate (n=14)		Difference (POST-PRE)	MORE Accurate (n=9)		Difference (POST-PRE)
			PRE Application	POST Application		PRE Application	POST Application	
D14	Funding Limitations for the Project	No	0.952	0.500	– 0.452	0.815	0.222	– 0.593
D16	Level of Political Pressure	Moderate	0.643	0.286	– 0.357	0.667	0.222	– 0.445
D28	Need for Residential Relocation	Substantial	0.929	0.714	– 0.215	0.963	0.444	– 0.519
D29	Level of Local Availability of Replacement Housing Facilities	Low	0.905	0.714	– 0.191	0.852	0.333	– 0.519
D11	Dedication of Funds to the Project (R/W and Construction)	Yes	0.929	0.786	– 0.143	0.852	0.222	– 0.630

8.2.2 Drivers for Utility Adjustment Duration Estimation

This section describes the results of validation for the influential drivers related to utility adjustment duration. As described in Chapter 7, nine drivers were identified as influential ones that showed large differences and high importance ratings between More Accurate and Less Accurate estimators in their perceptions of driver importance. In the validation pool, only three practitioners were grouped into the More Accurate category, and the Less Accurate category was assigned to only one expert, as described in Table 8.5.

Drivers #34 (Have SUE Investigation been Performed?) and #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility) were evaluated as having relatively low importance when More Accurate estimators' assessments were compared to the assessments of Less Accurate estimators. These two drivers are Utility Adjustment-related drivers. This pattern was also found in the validation pool. In addition to drivers #34 (Have SUE Investigation been Performed?) and #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility), there are two drivers #14 (Funding Limitations for the Project), and #11 (Dedication of Funds to the Project) related to Project Basic Facts. The Less Accurate estimators considered these drivers as having relatively low importance as compared to the assessments of More Accurate estimators. This evaluation pattern was easily found in the validation pool. However, the remaining drivers including #8, #7, #4, #38, and #41 were not validated.

Table 8.5: Validation Results: Most Influential Drivers for Utility Adjustment

Driver	Description	Original Pool			Validation Pool		
		PRE-Application		Diff (M-L)	PRE-Application		Diff (M-L)
		MORE Accurate (n=14)	LESS Accurate (n=11)		MORE Accurate (n=3)	LESS Accurate (n=1)	
D34	Have SUE Investigations Been Performed?	0.476	0.879	– 0.403	0.333	1.000	– 0.667
D14	Funding Limitations for the Project	0.929	0.576	0.353	0.444	0.000	0.444
D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	0.619	0.939	– 0.320	0.556	1.000	– 0.444
D11	Dedication of Funds to the Project (R/W and Construction)	0.833	0.576	0.257	0.889	0.000	0.889
D8	Status of Right-of-Way Map	0.952	0.818	0.134	1.000	1.000	0.000
D7	Status of Environmental Clearance	0.929	0.848	0.081	1.000	1.000	0.000
D4	Right-of-Way and Utility Scope	0.833	0.879	– 0.046	1.000	1.000	0.000
D38	Number of Utilities Located in Private Easement	0.857	0.879	– 0.022	0.889	0.000	0.889
D41	Responsiveness of Utility Companies to TxDOT Needs	0.905	0.909	– 0.004	0.889	0.000	0.889

As described in Table 8.6, the importance of drivers #14 (Funding Limitations for the Project) and #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility) decreased in the assessments of More Accurate estimators who viewed the actual values of these two drivers. This direction recurred in the validation pool.

In contrast, More Accurate estimators raised the importance level of driver #34 after knowing that SUE investigations had been performed. However, this pattern did not appear in the validation pool due to the limited sample size. While driver #11 (Dedication of Funds to the Project) was evaluated as having a relatively high importance in both the PRE-application and the POST-application importance assessments in project B, this finding was not validated by the validation pool as described in Table 8.6. The remaining drivers #8, #7, #4, #38, and #41 were not tested because the validation pool had different values of these drivers.

Table 8.6: Validation Results: Change in Importance of the Influential Drivers for Utility Adjustment Duration

Driver	Description	Value of Project B	Model Project B			Validation Pool		
			MORE Accurate (n=14)		Difference (POST-PRE)	MORE Accurate (n=3)		Difference (POST-PRE)
			PRE Application	POST Application		PRE Application	POST Application	
D34	Have SUE Investigations Been Performed?	Yes	0.476	0.714	0.238	0.333	0.333	0.000
D14	Funding Limitations for the Project	No	0.929	0.571	– 0.358	0.444	0.000	– 0.444
D42	Adjustment is Reimbursable Utility or Non-Reimbursable Utility	Both	0.619	0.571	– 0.048	0.556	0.333	– 0.223
D11	Dedication of Funds to the Project (R/W and Construction)	Yes	0.833	0.857	0.024	0.889	0.000	– 0.889

The drivers identified as influential ones for the durations of R/W acquisition and utility adjustment should be included in the RUDI tool as additional key data points. Among the influential drivers, some were already utilized in the development of the current version of RUDI.

Specifically, driver #1 (TxDOT Project Type) is one of the data points for the durations of utility adjustment in RUDI even though it was identified as a driver related to Project Basic Facts in this study. In addition to driver #1, driver #10 (District R/W Annual Budget) is also one of the Project Basic Facts-related drivers in this study. However, this driver is used for R/W acquisition duration estimation in the RUDI tool. Finally, driver #42 (Adjustment is Reimbursable Utility or Non-Reimbursable Utility) is already used as one of the key components in the utility adjustment duration estimation part of the RUDI tool. Except for these three drivers, the remaining ones should be considered to be additional key data points crucial to improving the RUDI tool's accuracy in the design phase of highway projects.

Chapter 9: Suggestions for Enhancing RUDI

Chapter 9, consisting of three sections, summarizes the findings from this study that can be used as suggestions for future RUDI improvements. Section 9.1 describes the results of the analysis of the drivers affecting schedule urgency and uncertainty, and it presents the revised percentile range interpretation matrix that can be useful in increasing the accuracy of the RUDI tool for the R/W acquisition and utility adjustment duration estimation. In Section 9.2, the most influential drivers are discussed, and these are those that indicate how estimators with more predictive accuracy differ from Less Accurate estimators when such estimators assess the importance of necessary drivers for forecasting the durations of the R/W acquisition and utility adjustment processes on a highway project. Section 9.3 articulates key suggestions toward reconstructing the RUDI tool to obtain better performance in predicting the durations of the R/W acquisition and utility adjustment processes in highway projects.

9.1 SCHEDULE URGENCY AND UNCERTAINTY FOR ESTIMATING DURATIONS

As described in Section 7.2, the RUDI tool was not very effective in assisting users' predictions of the durations of the R/W acquisition process. Specifically, the estimated durations of R2 (from Initial Appraisal to Possession of Parcel) based on RUDI were less accurate than the ones that depended on personal judgments. Conversely, the remaining durations (R3: from R/W Project Release to Possession of Parcel, U1: from R/W Project Release to Final Project Utility Adjustment Agreement Execution, and U3: from R/W Project Release to Final Project Utility Adjustment Completion) were relatively accurate when practitioners used the RUDI tool as compared to the duration estimations based on personal judgments. However, the non-RUDI-based estimated durations had large differences from the actual durations of the R/W acquisition and utility adjustment of project B. The large variability of the estimated durations based on RUDI may have been caused by a failure in assessing schedule urgency and uncertainty described in the percentile range guidance matrix. In other words, inaccurate evaluations of the drivers that affect schedule urgency and uncertainty led practitioners to select percentile ranges that did not represent the actual durations. However, it may be true that the practitioners may have had good reasons for their evaluations of the drivers, even if these reasons turned out to be wrong. Therefore, it is significantly important to see their evaluations of the drivers that affect schedule urgency and uncertainty, which were considered as project circumstances.

The following two Tables 9.1 and 9.2 describe how the schedule urgency and uncertainty of project B were evaluated by study respondents (n=43) and summarize the percentile ranges utilized in predicting the durations of the R/W acquisition and utility adjustment. Table 9.1 depicts the percentile ranges used in forecasting the R/W acquisition durations of project B. As this table describes, the 10-50th and 30-70th percentiles were the most frequently used ranges, while the 10-40th and 30-60th percentiles were used by six respondents. This usage pattern indicates that the degree of uncertainty of project B was evaluated as being moderate to high by practitioners, and the schedule of project B was considered to be moderately urgent to highly urgent. Moreover, only seven practitioners perceived this project as having low urgency in scheduling, and three practitioners evaluated the uncertainty of project B being of a low degree. Therefore, because of these responses the mean degree of schedule urgency and uncertainty can be positioned in the middle of the high and moderate zones as illustrated by Table 9.1. The black dot mark in the table represents this mean degree of schedule urgency and uncertainty.

Table 9.1: Percentile Ranges Used in R/W Acquisition Duration Estimation of Project B

All Estimators (N=43)		Percentile Ranges Used for R/W Acquisition Duration Estimation		
		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
		2	6	10
	Moderate	30-50	30-60	30-70
		1	6	11
	Low	50-70	50-80	50-90
			5	2

Table 9.2 summarizes the percentile ranges used for estimating the durations of the utility adjustment of project B. As described in Table 9.2, the overall usage pattern is the same as the percentile ranges used for the R/W acquisition duration estimation. For the degree of schedule urgency, respondents assigned rankings of high, moderate, and low. Uncertainty was evaluated by most respondents as having moderate or high degrees for estimating the durations of the utility adjustment. The black dot mark showing the mean degree of schedule urgency and uncertainty can be positioned in the middle zone of the moderate and high categories of schedule urgency and uncertainty.

Table 9.2: Percentile Ranges Used in Utility Adjustment Duration Estimation of Project B

All Estimators (N=43)		Percentile Ranges Used for Utility Adjustment Duration Estimation		
		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
		3	7	8
	Moderate	30-50	30-60	30-70
			4	10
	Low	50-70	50-80	50-90
			8	3

The data represented in Tables 9.1 and 9.2 above represented the practitioners' evaluations of schedule urgency and uncertainty did not help them choose right percentile ranges for predicting the durations of the R/W acquisition and utility adjustment processes. In other words, unreasonable understanding of the drivers affecting schedule urgency and uncertainty may have caused these evaluations of schedule urgency and uncertainty. Therefore, examining respondents who produced relatively accurate durations was a necessary step because doing so can identify the characteristics of More Accurate estimators in terms of assessing schedule urgency and uncertainty. Such characteristics should be identified prior to duration estimation. The findings from this examination are described in the following two sections.

9.1.1 Drivers for Assessing Schedule Urgency and Uncertainty

In Sections 9.1.1, 9.1.2, and 9.1.3, the percentile ranges utilized by respondents with different levels of duration accuracy were examined, and then respondents' perceptions of the importance of drivers that affect schedule urgency and uncertainty were analyzed to see if significant distinctions between More Accurate and Less Accurate estimators exist.

During the RUDI training sessions, the research team suggested several factors that should be used in assessing both schedule urgency and uncertainty. As described in Table 9.3, four factors were suggested as affecting schedule urgency: (1) level of political pressure; (2) relative highway user costs involving traffic delays; (3) level of district R/W support resources available; and (4) contract letting pressure. Based on these proposed factors, the drivers described in Table 9.3 were selected from the list of 42 drivers for the schedule urgency assessment, although the last two factors did not have drivers associated with them. Drivers #15 (Level of Acceptance of the Project by the Public) and #16 (Level of Political Pressure) were selected for the first factor, level of political pressure. The second factor regarding the availability of district R/W support resources included four drivers: #23 (Availability of District R/W appraisers); #24 (Is Funding Available for Outsourcing Staff Assistance?); #29 (Level of Local Availability of Replacement Housing Facilities); and #31 (Level of Local Availability of Replacement Business Facilities). No drivers were related to the remaining two factors because experts did not recognized these factors as main characteristics of highway projects with R/W acquisition and utility adjustment.

Table 9.3: Drivers Relevant to Assessing Schedule Urgency

Drivers as Suggested during RUDI Training Sessions	Drivers From the List of 42 Key Drivers
▪ Level of Political Pressure ▪ Level of district R/W support resources available ▪ Relative highway user costs involving traffic delays ▪ Contract letting pressure	▪ Level of Acceptance of the Project by the Public (D15) ▪ Level of Political Pressure (D16) ▪ Availability of District R/W Appraisers (District Staff and Outsourced) (D23) ▪ Is Funding Available for Outsourcing Staff Assistance? (D24) ▪ Level of Local Availability of Replacement Housing Facilities (D29) ▪ Level of Local Availability of Replacement Business Facilities (D31)

Table 9.4 describes the list of drivers selected from the 42 key drivers based on the proposed factors for uncertainty. These factors include the following six: (1) project scope; (2) familiarity with local landowners; (3) knowledge of existing utility facilities; (4) level of cooperation between DOT and local utilities; (5) project funding limitations (relative to cost); and (6) uncertainties of property title acquisition. The first factor, project scope, included four drivers related to the status of preliminary design phases: #5 (Status of Schematic Design); #6 (Status of Boundary Surveying); #7 (Status of Environmental Clearances); and #8 (Status of Right-of-Way Map), and two drivers related to R/W Acquisition and Utility Adjustment: #19 (Number of Parcels for

Acquisition) and #39 (Number of Utilities for Adjustment or Relocations). Through checking the status of these preliminary design phases, users can obtain information about the parameters of the project at the planning stage. Along with these drivers, identifying number of parcels and utilities is also helpful in defining the scope of a project. In addition, drivers #26 (Level of Familiarity with Key Landowners) and #34 (Have SUE Investigations been Performed?) were selected for the factors familiarity with local landowners and knowledge of existing utility facilities, respectively. Driver #41 (Responsiveness of Utility Companies to TxDOT) was related to the level of cooperation between DOT and local utilities, and driver #14 (Funding Limitations for the Project) related to the factor project funding limitations (relative to cost). Finally, driver #32 (Likelihood of Title Curative Actions) can be deemed to be related to uncertainties of property title acquisition.

Table 9.4: Drivers Relevant to Assessing Uncertainty

Drivers as Suggested during RUDI Training Sessions	**Drivers From the List of 42 Key Drivers**
▪ Project scope ▪ Familiarity with local landowners ▪ Knowledge of existing utility facilities ▪ Level of cooperation between DOT and local utilities ▪ Project funding limitations (relative to cost) ▪ Property title-related uncertainties	▪ Status of Schematic Design (D5) ▪ Status of Boundary Surveying (D6) ▪ Status of Environmental Clearances (D7) ▪ Status of Right-of-Way Map (D8) ▪ Funding Limitations for the Project (D14) ▪ Number of Parcels for Acquisition (D19) ▪ Level of Familiarity with Key Landowners (D26) ▪ Likelihood of Title Curative Actions (D32) ▪ Have SUE Investigations been Performed? (D34) ▪ Number of Utilities for Adjustments or Relocations (D39) ▪ Responsiveness of Utility Companies to TxDOT Needs (D41)

The POST-application importance of these drivers described in Tables 9.3 and 9.4 was analyzed in the following sections based on the percentile ranges selected by More Accurate and Less Accurate estimators in R/W acquisition and utility adjustment duration to see if distinctive differences exist in experts' perceptions of the drivers important in assessing schedule urgency and uncertainty.

9.1.2 Assessment of Schedule Urgency and Uncertainty for R/W Acquisition Durations

The actual duration of R2 of project B was 762 days, which is represented as the 82$^{\text{nd}}$ percentile derived from the practitioners' estimations. This actual percentile of R2 is included in the 50-90$^{\text{th}}$ percentile range as described in Table 9.5. In order to use the 50-90$^{\text{th}}$ percentile range that can lead users to maximize the accuracy when predicting R2, therefore, users should evaluate the degree of uncertainty and schedule urgency of project B as being high and low, respectively. That is, only this percentile range provided practitioners with duration ranges including the actual duration of R2, 762 days.

Table 9.5: Actual Percentile Range of R2

Percentile Range		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
	Moderate	30-50	30-60	30-70
	Low	50-70	50-80	50-90
				X = 82%-tile

In addition to R2, the actual duration of R3 was 796 days, and the 63$^{\text{rd}}$ percentile represents this number. This percentile range is included in four (30-70$^{\text{th}}$, 50-70$^{\text{th}}$, 50-80$^{\text{th}}$, and 50-90$^{\text{th}}$) percentile ranges in the percentile range guidance matrix, as illustrated by Table 9.6. All three levels of uncertainty can be appropriate in forecasting the R3 duration. However, for schedule urgency, moderate and low levels should be chosen to utilize these percentile ranges covering the actual percentile of R3.

Table 9.6: Actual Percentile Range of R3

Actual Percentile Range		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
	Moderate	30-50	30-60	30-70
				X = 63%-tile
	Low	50-70	50-80	50-90
		X = 63%-tile	X = 63%-tile	X = 63%-tile

During the data collection process, study participants were able to select one percentile range for forecasting the durations of both R/W acquisition and utility adjustment or to use two ranges, one for each process. Table 9.7 describes the percentile range selections of More Accurate estimators for R/W acquisition duration. The distinctive pattern emerging from More Accurate estimators' selections is that these estimators evaluated uncertainty as being moderate or high, and the considered schedule urgency to be moderate or low. Because of these results, the black dot representing the mean degree of schedule urgency and uncertainty can be positioned between moderate and high for uncertainty and between low and moderate for schedule urgency.

Table 9.7: Percentile Range of More Accurate Estimators in RUDI-based R/W Acquisition Duration Estimation

More Accurate (n=14)		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
				3
	Moderate	30-50	30-60	30-70
			2	3
	Low	50-70	50-80	50-90
			4	2

As described in Table 9.8, those practitioners identified as the Less Accurate ones in the R/W acquisition duration estimation showed significantly different assessments of both the degree of schedule urgency and uncertainty as compared to the assessments of More Accurate estimators. Nine out of 12 these estimators perceived the schedule urgency of project B to be high. In addition, the mean degree of schedule uncertainty and urgency can be represented between moderate and high for uncertainty and between moderate and high for schedule urgency.

Tables 9.7 and 9.8 clearly present to what extent different practitioners with different levels of duration accuracy rate schedule urgency and uncertainty. As mentioned earlier, the More Accurate estimators considered the degree of schedule urgency of project B to be between low and moderate. In other words, there was a significant difference in assessing schedule urgency between More Accurate and Less Accurate estimators. This difference led the author to analyze how practitioners with different levels of accuracy evaluated the importance of drivers that affect schedule urgency and uncertainty in predicting the durations of the R/W acquisition and utility adjustment.

Table 9.8: Percentile Range of Less Accurate Estimators in RUDI-based R/W Acquisition Duration Estimation

Less Accurate (n=12)		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
		1	3	5
	Moderate	30-50	30-60	30-70
				2
	Low	50-70	50-80	50-90
			1	

Among the drivers affecting schedule urgency, More Accurate estimators evaluated driver #31 (Level of Local Availability of Replacement Business Facilities) as having high importance (0.857), while Less Accurate estimators considered this driver to be insignificant (0.083). As depicted in Table 9.9, a low level of local availability of replacement business facilities may decrease the degree of schedule urgency for Less Accurate estimators. In addition, these two groups of estimators showed different perceptions of the POST-application importance of driver #16 (Level of Political Pressure). Therefore, it appears that the large difference (> 0.2) between the two groups of estimators in their assessments of these driver may have resulted in More Accurate estimators evaluating schedule urgency as being moderate to low and Less Accurate estimators evaluating its urgency as being high.

Conversely, there were no significant differences (> 0.2) in the practitioners' assessments of the importance of the remaining four drivers with different impacts on schedule urgency depending on the values given to each driver. These drivers include #15 (Level of Acceptance of the Project by the Public), #29 (Level of Local Availability of Replacement Housing Facilities), #23 (Availability of District R/W Appraisers-District Staff and Outsourced), and #24 (Is Funding Available for Outsourcing Staff Assistance).

In order to increase the reliability of this finding that is critical in choosing appropriate percentile ranges, it needs to be validated by assigning different values to the drivers than this study.

Table 9.9: Drivers Affecting Schedule Urgency: Comparison of More Accurate and Less Accurate Estimators in RUDI-based R/W Acquisition Duration Estimation

Driver	Description of Driver	Value of Project B	Degree of Schedule Urgency			POST-Application		Difference (M-L)
			L	M	H	More Accurate (n=14)	Less Accurate (n=12)	
D31	Level of Local Availability of Replacement Business Facilities	Low	●	○	○	0.857	0.083	0.774
D16	Level of Political Pressure	Moderate	○	●	○	0.714	0.333	0.381
D15	Level of Acceptance of the Project by the Public	Extensive	○	○	●	0.571	0.417	0.154
D29	Level of Local Availability of Replacement Housing Facilities	Low	●	○	○	0.571	0.583	– 0.119
D23	Availability of District R/W Appraisers (District Staff and Outsourced)	Marginally adequate	○	●	○	0.357	0.417	– 0.060
D24	Is Funding Available for Outsourcing Staff Assistance?	Yes	○	○	●	0.286	0.333	– 0.047

Similar to the drivers for schedule urgency, the drivers listed in Table 9.10 were identified as potential drivers affecting uncertainty by the research team. More and Less Accurate estimators showed large differences (> 0.2) in evaluating the POST-application importance of drivers #19 (Number of Parcels for Acquisition), #41 (Responsiveness of Utility Companies to TxDOT Needs), and #26 (Level of Familiarity with Key Landowners). These More Accurate estimators ranked these aforementioned drivers as having relatively high importance, contrary to the Less Accurate estimators. Moreover, these drivers with specific values may possess different impacts on the level of uncertainty as depicted in Table 9.10 according to More Accurate estimators. Specifically, a high level of familiarity with key landowners definitely lowers the degree of uncertainty. In addition, if local utility companies respond very effectively and quickly to TxDOT needs, it will also decrease the degree of uncertainty. However, if SUE investigations have not been performed at the planning phase, it will cause a high degree of uncertainty. Moreover, the POST-application importance of the remaining eight drivers was not significantly different in the assessments of More and Less Accurate estimators after knowing real values.

Table 9.10: Drivers Affecting Uncertainty: Comparison of More Accurate and Less Accurate Estimators in RUDI-based R/W Acquisition Duration Estimation

Driver	Description of Driver	Value of Project B	Degree of Uncertainty			POST-Application		Difference (M-L)
			L	M	H	More Accurate (n=14)	Less Accurate (n=12)	
D19	Number of Parcels for Acquisition	More than 30	●	○	○	0.786	0.250	0.536
D41	Responsiveness of Utility Companies to TxDOT Needs	High	●	○	○	0.857	0.500	0.357
D26	Level of Familiarity with Key Landowners	High	●	○	○	0.929	0.583	0.346
D8	Status of Right-of-Way Map	Completed	●	○	○	0.500	0.667	– 0.167
D39	Number of Utilities for Adjustments or Relocations	More than 7	●	○	○	0.643	0.500	0.143
D14	Funding Limitations for the Project	No	●	○	○	0.857	0.750	0.107
D32	Likelihood of Title Curative Actions	High	○	○	●	0.857	0.750	0.107
D6	Status of Boundary Surveying	Completed	●	○	○	0.500	0.583	0.083
D5	Status of Schematic Design	Completed	●	○	○	0.571	0.500	0.071
D34	Have SUE Investigations been Performed?	No	○	○	●	0.571	0.500	0.071
D7	Status of Environmental Clearances	Completed	●	○	○	0.571	0.583	– 0.012

Based on the results of the previous analyses described above, it appears that perceptual differences exist among More Accurate and Less Accurate estimators in terms of evaluating project circumstances that are related to schedule urgency and uncertainty for forecasting the durations of the R/W acquisition process.

9.1.3 Assessment of Schedule Urgency and Uncertainty for Utility Adjustment Durations

The actual delivery time of the utility adjustment process of project B, which was used as the main source for the data collection of this study, was 1131 days. This number represents the completion of the final project utility adjustment agreement execution, which was defined as the last milestone for U1. The actual percentile representing this real-time duration is the 54th as Table 9.11 illustrates. The 54th percentile is included in the five ranges shown in the percentile range interpretation matrix. In order to utilize these percentile ranges that may represent duration ranges including the accurate one of 1131 days for U1, users should make an appropriate decision about the degree of schedule urgency. As depicted in Table 9.11, all three levels of uncertainty are available for selection. However, users can choose one of the five percentile ranges including the actual percentile of U1 when schedule urgency is evaluated as being moderate or low.

Table 9.11: Actual Percentile Range of U1

Actual Percentile Range		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
	Moderate	30-50	30-60	30-70
			X = 54%-tile	X = 54%-tile
	Low	50-70	50-80	50-90
		X = 54%-tile	X = 54%-tile	X = 54%-tile

Along with U1, U3, which was defined as the duration from R/W Project Release to Final Project Utility Adjustment Completion, took 1203 days. The actual percentile range of U3 is the 56^{th,} and this percentile is included in the same percentile ranges as those applied in U1 as indicated in Table 9.12. Therefore, while all three levels of uncertainty are available, schedule urgency should be evaluated as being moderate or low.

Table 9.12: Actual Percentile Range of U3

Actual Percentile Range		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
	Moderate	30-50	30-60	30-70
			X = 56%-tile	X = 56%-tile
	Low	50-70	50-80	50-90
		X = 56%-tile	X = 56%-tile	X = 56%-tile

As illustrated by Table 9.13, the 30-70th and 50-80th percentile ranges were selected by eight and two More Accurate estimators chose the 10-50th and 30-60th percentile ranges, respectively. The distinctive pattern in Table 8.13 is that the majority of More Accurate estimators in the utility adjustment duration estimation evaluated project B's degree of uncertainty as moderate or high, while schedule urgency was considered to be moderate or low. Therefore, the mean degree point of schedule urgency and uncertainty can be located at the area between moderate / high for uncertainty and moderate / low for schedule urgency.

Table 9.13: Percentile Range of More Accurate Estimators in RUDI-based Utility Adjustment Duration Estimation

More Accurate (n=14)		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
				2
	Moderate	30-50	30-60	30-70
		1	2	4
	Low	50-70	50-80	50-90
			4	1

In the assessments of the Less Accurate estimators, assigning a low level of schedule urgency and uncertainty was apparently not considered to be appropriate for obtaining reasonable duration ranges as represented by percentile ranges in the RUDI tool. As Table 9.14 shows, the higher percentile ranges (50-70th, 50-80th, and 50-90th) were not utilized by Less Accurate estimators for estimating the durations of the utility adjustment process. These ranges are significantly different from those selected by the More Accurate estimators. The black dot representing the mean degree of schedule urgency and uncertainty of Less Accurate estimators shows that these estimators considered the schedule urgency of project B to be higher than that of the More Accurate estimators in the utility adjustment duration estimation.

Table 9.14: Percentile Range of Less Accurate Estimators in RUDI-based Utility Adjustment Duration Estimation

Less Accurate (n=11)		Degree of Uncertainty		
		Low	Moderate	High
Degree of Schedule Urgency	High	10-30	10-40	10-50
		1	3	3
	Moderate	30-50	30-60	30-70
			2	2
	Low	50-70	50-80	50-90

Table 9.15 describes how More Accurate and Less Accurate estimators evaluated the POST-application importance of the drivers that affect schedule urgency in selecting the appropriate percentile ranges provided by RUDI. Drivers #29 (Level of Local Availability of Replacement Housing Facilities) and #24 (Is Funding Available for Outsourcing Staff Assistance?) were evaluated differently by More Accurate and Less Accurate estimators. The possible impacts of these drivers with large differences in

terms of evaluation of schedule urgency were determined based on the values of project B, as Table 9.15 also shows.

The remaining four drivers #16 (Level of Political Pressure), #31 (Level of Local Availability of Replacement Business Facilities), #23 (Availability of District R/W Appraisers) and #15 (Level of Acceptance of the Project by the Public) did not show significant differences among these two groups of experts in the POST-application importance assessments.

Table 9.15: Drivers Affecting Schedule Urgency: Comparison of More Accurate and Less Accurate Estimators in RUDI-based Utility Adjustment Duration Estimation

Driver	Description of Driver	Value of Project B	Degree of Schedule Urgency			POST-Application		Difference (M-L)
			L	M	H	More Accurate (n=14)	Less Accurate (n=11)	
D29	Level of Local Availability of Replacement Housing Facilities	Low	●	○	○	0.905	0.636	0.269
D24	Is Funding Available for Outsourcing Staff Assistance?	Yes	○	○	●	0.500	0.727	– 0.227
D16	Level of Political Pressure	Moderate	○	●	○	0.667	0.485	0.182
D31	Level of Local Availability of Replacement Business Facilities	Low	●	○	○	0.643	0.485	0.158
D23	Availability of District R/W Appraisers (District Staff and Outsourced)	Marginally adequate	○	●	○	0.714	0.727	– 0.013
D15	Level of Acceptance of the Project by the Public	Extensive	○	○	●	0.500	0.500	0.000

Four out of 11 drivers showed large differences (> 0.2) between More Accurate and Less Accurate estimators in terms of their assessments of uncertainty. Specifically, drivers #6 (Status of Boundary Surveying) #8 (Status of Right-of-Way Map), #39(Number of Utilities for Adjustments or Relocations), #34 (Have SUE Investigations been Performed?) showed significantly large differences (> 0.2) between More Accurate and Less Accurate estimators as illustrated by Table 9.16. Moreover, the given values of three drivers among them were expected to decrease the degree of uncertainty. More specifically, given that schematic design and R/W mapping had been completed could remove some of the uncertainties surrounding the project because participants could easily obtain information about the project scope and its circumstances.

The remaining seven drivers #7 (Status of Environmental Clearances), #26 (Level of Familiarity with Key Landowners), #41 (Responsiveness of Utility Companies to TxDOT), #32 (Likelihood of Title Curative Actions), #14 (Funding Limitations for the Project), #6 (Status of Boundary Surveying), and #19 (Number of Parcels for Acquisition) did not show large differences between the two groups of experts in estimating the durations of the utility adjustment.

Table 9.16: Drivers Affecting Uncertainty: Comparison of More Accurate and Less Accurate Estimators in RUDI-based Utility Adjustment Duration Estimation

Driver	Description of Driver	Value of Project B	Degree of Uncertainty			POST-Application		Difference (M-L)
			L	M	H	More Accurate (n=14)	Less Accurate (n=11)	
D5	Status of Schematic Design	Completed	●	○	○	0.273	0.786	– 0.513
D8	Status of Right-of-Way Map	Completed	●	○	○	0.571	0.273	0.298
D39	Number of Utilities for Adjustments or Relocations	More than 7	●	○	○	0.857	0.636	0.221
D34	Have SUE Investigations been Performed?	No	○	○	●	0.571	0.364	0.207
D7	Status of Environmental Clearances	Completed	●	○	○	0.714	0.545	0.169
D26	Level of Familiarity with Key Landowners	High	●	○	○	0.714	0.545	0.169
D41	Responsiveness of Utility Companies to TxDOT Needs	High	●	○	○	0.786	0.636	0.150
D32	Likelihood of Title Curative Actions	High	○	○	●	0.571	0.500	0.071
D14	Funding Limitations for the Project	No	●	○	○	0.571	0.636	– 0.065
D6	Status of Boundary Surveying	Completed	●	○	○	0.571	0.545	0.026
D19	Number of Parcels for Acquisition	More than 30	●	○	○	0.571	0.545	0.026

Based on the results described in Sections 9.1.2 and 9.1.3, the drivers showing any differences between More Accurate and Less Accurate estimators in the POST-application importance assessments should be considered in evaluating schedule urgency and uncertainty even though some drivers did not present large differences (> 0.2) in the comparison of More Accurate and Less Accurate estimators.

9.1.4 Revision of the Percentile Range Guidance Matrix

As outlined in the introduction to this chapter, the initial durations predicted by most practitioners were underestimated when compared to the actual durations of project B. This pattern may have resulted from inappropriate evaluations of schedule urgency and uncertainty as described in the previous sections. In addition to such inaccurate evaluations of schedule urgency and uncertainty, another possible cause for this pattern is that most practitioners had optimistic opinions for the project. They tended to report that these pre-construction tasks would not require significant amounts of time. Such optimistic attitudes may have encouraged most practitioners to choose a medium rather than high number from the duration ranges represented as percentile ranges. Given these factors, revising the percentile range interpretation matrix was a critical effort intended to prevent estimators from underestimating or overestimating the durations needed in acquiring properties and adjusting underground or on ground utilities. This necessity became apparent when the researcher investigated the estimated durations of More Accurate estimators in the R/W acquisition and utility adjustment processes, although the selection pattern needs to be validated by testing different samples to increase the pattern's reliability. Most of the More Accurate estimators attempted to determine a maximum number within the ranges recommended by RUDI or choose a number exceeding the higher duration within the ranges.

Based on the findings from the analysis of drivers affecting schedule urgency and uncertainty as well as the estimation pattern of those practitioners with better predictive accuracy, the following percentile range guidance matrix, depicted in Table 9.17, was recommended, and it represents a revision of the older matrix. Ten percentage points were added to the highest percentile of each range to increase the duration ranges represented by each percentile range in RUDI, while the lower percentiles were not adjusted. Although this approach was based on only the observations from the duration selection pattern of More Accurate estimators in both R/W acquisition and utility adjustment duration estimation of project B, the revised matrix can be helpful in improving the accuracy of estimations based on RUDI because practitioners will be able to select a higher mid-range number from the wider ranges. Ultimately, this principle can be useful in preventing estimators from extreme underestimation of durations needed for R/W acquisition and utility adjustment. However, as previously mentioned, additional projects including various characteristics need to be investigated in order to increase the reliability of the revised percentile range guidance matrix.

Table 9.17: Recommended Percentile Range Guidance Matrix

		Degree of Uncertainty		
		Low	**Moderate**	**High**
Degree of Schedule Urgency	**High**	10-40	10-50	10-60
	Moderate	30-60	30-70	30-80
	Low	50-80	50-90	50-99

9.2 RECONSTRUCTION OF RUDI

This section, consisting of four parts, summarizes a list of methodological suggestions that can be incorporated in reconstructing the RUDI tool for improving its performance in helping experts estimate the durations of the R/W acquisition and utility adjustment processes. Based on the findings from the analyses detailed previously in this study, how to include additional drivers into the RUDI tool is described in the first part. The second part describes information sources that can be utilized to collect data about additional key drivers. In order to improve the accuracy of the RUDI tool, a revised application process is described in the third part, and then groups of suggestions to be conducted to enhance the functions embedded within the RUDI tool are described in the last section.

9.2.1 Inclusion of the Influential Drivers

The current version of RUDI includes only four drivers for estimating the durations of the R/W acquisition process as mentioned earlier. They include the following: (1) number of parcels; (2) location type; (3) district R/W annual budget; and (4) district R/W staff size. Along with these current drivers, additional drivers identified from the analysis of the PRE-application driver importance assessment were added to the R/W acquisition duration part of the RUDI tool as described in Figure 9.1.

Drivers needed in determining durations for R/W acquisition were divided into two categories: (1) Project Basic Facts- and (2) R/W Acquisition-related. Ten drivers in the group of Project Basic Facts-related drivers include: (1) TxDOT Project Type; (2) Project Location Type; (3) Internal R/W Staff Size of a District; (4) District R/W Annual Budget; (5) Dedication of Funds to the Project; (6) Funding Limitations for the Project; (7) Level of Political Pressure; (8) Status of Environmental Clearance; (9) R/W and

Utility Scope, and; (10) Status of Right-of-Way Map. The group of R/W Acquisition-related drivers consisted of five: (1) Number of Parcels for Acquisition; (2) Need for Residential Relocation; (3) Likelihood of Title Curative Actions; (4) Level of Local Availability of Replacement Housing Facilities, and; (5) Frequency of Eminent Domain. As depicted in Figure 9.1, the newly suggested structure for R/W acquisition durations reorganized and renamed four drivers that were already included in RUDI.

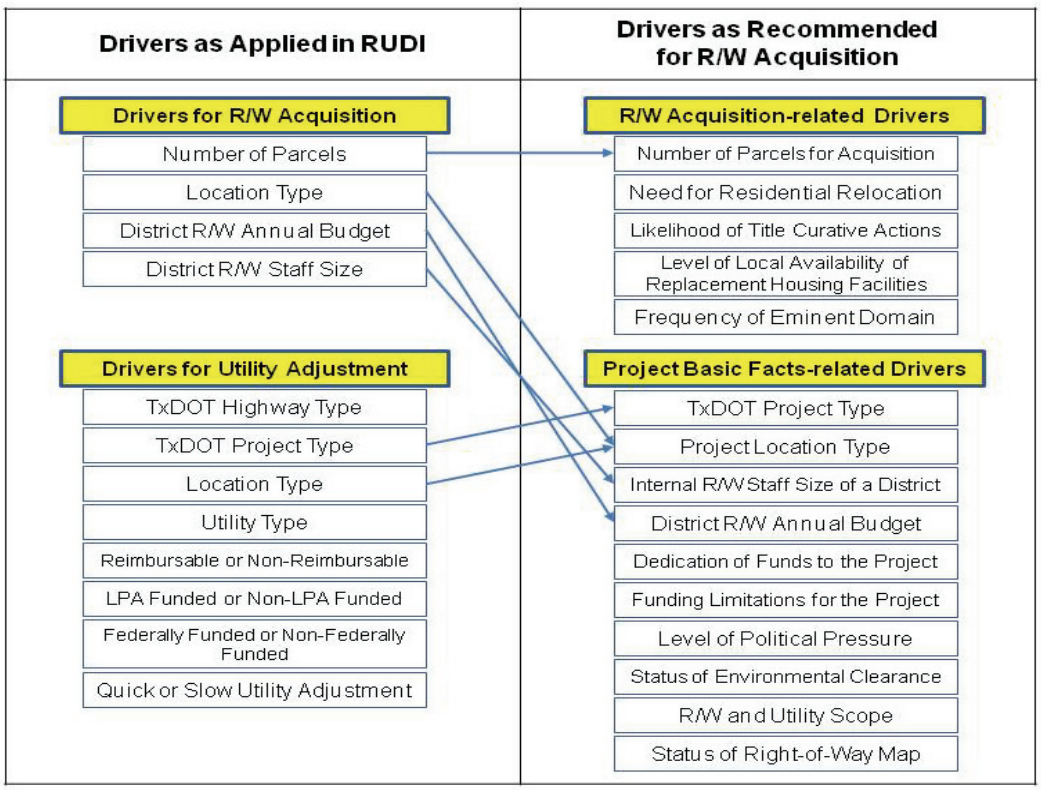


Figure 9.1: Recommended Drivers for R/W Acquisition Duration

For utility adjustment durations, 10 drivers related to Project Basic Facts and five Utility Adjustment-related drivers were included as depicted in Figure 9.2. Except for five drivers that are involved in the current RUDI tool, additional five drivers related to the category of Project Basic Facts-related were added: (1) Funding Limitations for the

Project; (2) Dedication of Funds to the Project; (3) Status of Right-of-Way Map; (4) Status of Environmental Clearance, and; (5) R/W and Utility Scope. The category of Utility Adjustment-related consists of three additional and two drivers that are already used in the current tool. Drivers "Have SUE Investigations been Performed?," "Number of Utilities Located in Private Easement," and "Responsiveness of Utility Companies to TxDOT Needs" were identified from the PRE-application importance assessments. In contrast, "Utility Type" and "Adjustment is Reimbursable Utility or Non-Reimbursable Utility" were considered key drivers in the current RUDI tool. However, "Quick or Slow Utility Adjustment" was discarded because the experts that were consulted for identifying the 42 key drivers did not consider this driver to be significant.

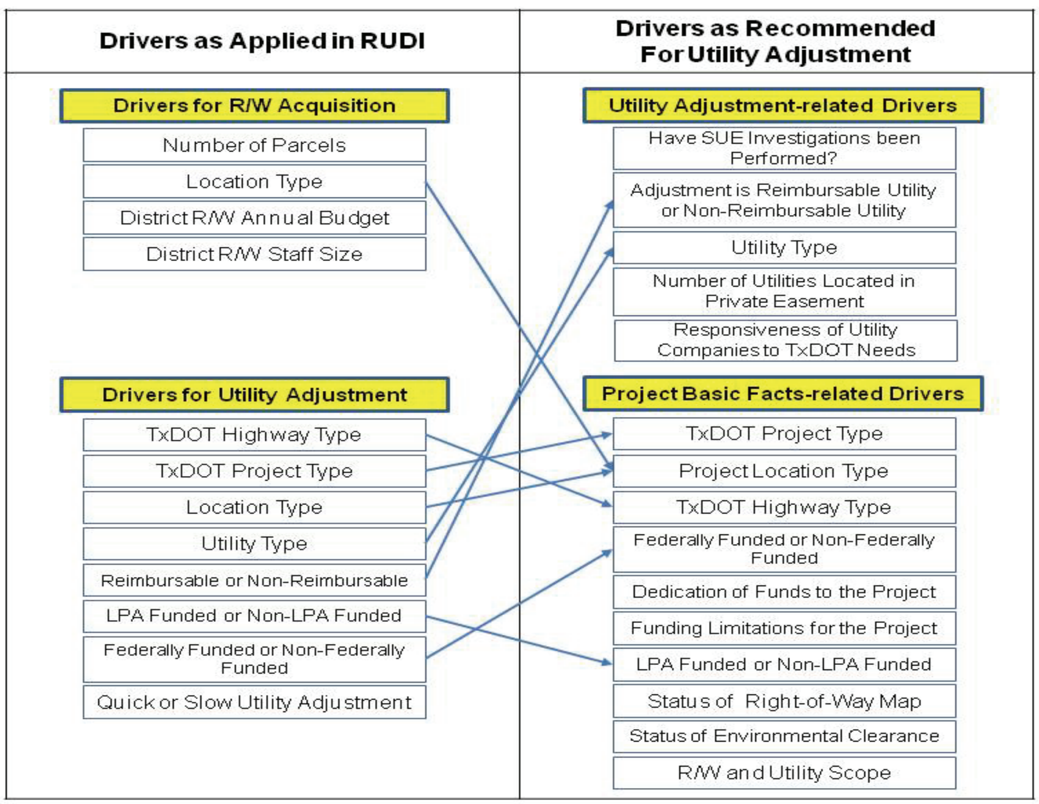


Figure 9.2: Recommended Drivers for Utility Adjustment Duration

9.2.2 Recommendations for RUDI Application Process

The RUDI tool has proven to be more accurate in helping experts make estimations as compared to the duration estimations based on experts' personal judgments alone. However, the improved accuracy of using the RUDI tool was not enough to prevent users from underestimating or overestimating the durations of the R/W acquisition and utility adjustment processes. The potential causes for this performance are the following three: (1) only four and eight drivers were used for R/W acquisition duration and utility adjustment estimations, respectively; (2) the RUDI application process as applied in this study was based on the utilization of limited drivers in interpreting schedule urgency and uncertainty for predicting the durations of the R/W acquisition and utility adjustment processes; and (3) experts select only one percentile range to gather duration ranges provided by RUDI. Figure 9.3 describes the overall application process of the current version of RUDI.

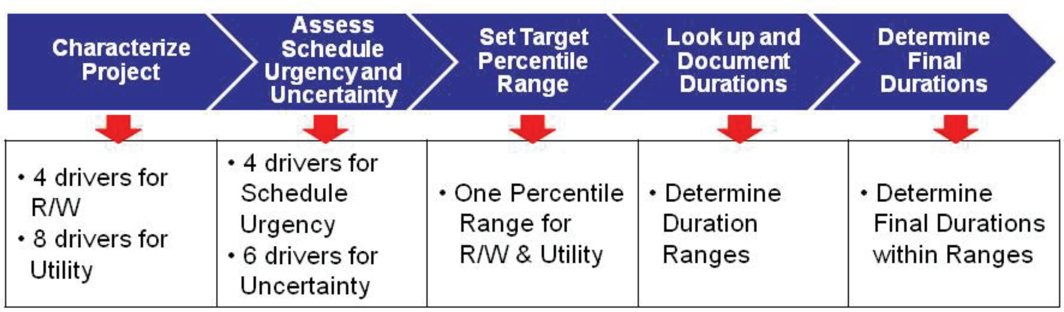


Figure 9.3: RUDI Application Process as Applied

In order to resolve those problems described earlier, additional drivers that should be included in assessing schedule urgency and uncertainty were identified. In addition, through analyzing perceptual differences among experts in assessing the importance of drivers affecting the durations of the R/W acquisition and utility adjustment processes, additional data points emerged that were divided into three categories, including Project Basic Facts-, R/W Acquisition-, and Utility Adjustment-related.

Along with identifying additional key drivers and developing rules for their application, the RUDI application process was revised to enhance its performance in predicting the durations of R/W acquisition and utility adjustment as described in Figure 9.4.

These application rules developed include the following. First, users need to characterize a given project using the newly recommended 15 drivers, respectively, for R/W acquisition and utility adjustment durations. Following this project characterization process, an appropriate assessment of schedule urgency and uncertainty should be conducted to get reasonable percentile ranges for the estimation. Based on those drivers set forth in Section 9.1, users should interpret project circumstances including schedule urgency and uncertainty. In this step, separately evaluating these circumstances for the R/W acquisition and utility adjustment is strongly recommended because each process has distinctive characteristics and includes drivers with different levels of influence. The selection of percentile ranges for each process to be estimated is the third phase of the revised RUDI application process. The fourth phase includes recording the duration ranges provided by RUDI. In the fifth and final phase, users should select a single duration range from the various durations ranges represented by the percentile ranges for each driver. The most reasonable range can be selected by choosing the highest number from the lower durations represented by the lower percentile ranges and the lowest number from the durations represented by the higher percentile ranges. This pattern of selection is useful in narrowing the ranges and in reducing the variability of the estimated durations among users.

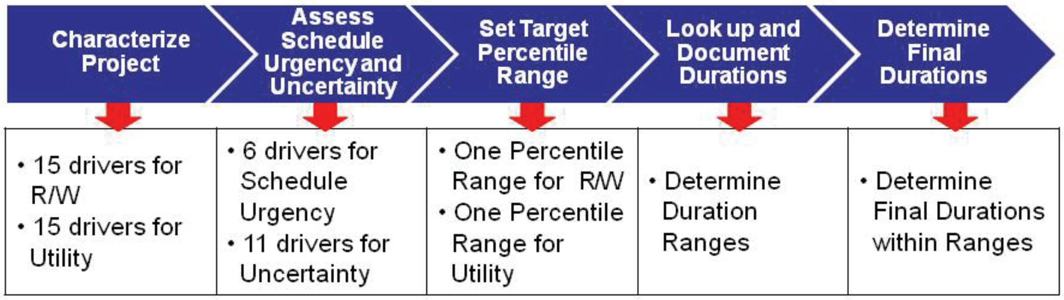


Figure 9.4: RUDI Application Process as Recommended

Along with the revised RUDI application process, additional studies should be conducted in order to generate further suggestions regarding the functions and structure of RUDI and to improve the accuracy of RUDI in predicting the durations of the R/W acquisition and utility adjustment processes. A list of suggestions for future RUDI enhancements is described in the following section.

9.2.3 Suggested Improvements to RUDI

The following comments include suggested improvements that need to be completed for future RUDI system development. Most of these improvements can be characterized as long-term goals of studies can follow up upon this implementation research study.

1) RUDI should include a function allowing for parallel analysis that would enable users both to search for and filter data about completed projects that are similar to their own. If users had specific information about their project characteristics, they could then find a sample of other past and current projects with characteristics that match those of their own. RUDI would become a database in which all knowledge about durations is stored and from which such knowledge could be quickly recovered.

2) Enable RUDI to consider two or more duration factors at the same time: Currently RUDI displays the data concerning one variable at a time. That is, users can only display R/W durations by selecting the number of parcels or any of the other given variables. Instead, RUDI should allow users to select multiple variables at the same time so they may have a more precise match of data according to their project characteristics. For example, RUDI should allow users to select both the number of parcels and the project's location simultaneously and then retrieve that information for the users.

3) Enable ROWIS to allow users to have real time access to TxDOT highway project data: Although TxDOT already documents much of the needed data in ROWIS, some of these data could be integrated with a dynamic database or tool enabling users to have real time access to projects durations. This effort would require developing the database and then keeping it updated on a weekly or monthly basis, but if done well the benefits for the estimation process would be invaluable.

4) Collect data from different kinds of recent and actual projects and add them to the RUDI database: It is necessary to collect Right-of-Way (R/W) acquisition and utility adjustment data mainly from urban and metropolitan districts because RUDI currently presents more information regarding rural projects.

5) Collect data related to highly important variables used in estimates: RUDI presents the user with few important variables to guide their estimate (e.g., number of parcels, location, and district annual budget for R/W durations). Even though these variables are important, this study has shown that users consider many other variables to be important when they estimate durations.

6) Include highways projects with unusual circumstances such as a large number of parcels (more than 100 parcels) or different transportation projects like railroads. Data about highway projects with these unusual conditions can be useful in improving the RUDI tool for better duration estimations.

Chapter 10: Conclusions and Recommendations

10.1 Review of Study Objectives and Hypotheses

The primary purpose of this study as set forth in Chapter 1 was to understand how practitioners can better estimate durations needed for R/W acquisition and utility adjustment on highway projects. Toward achieving this main goal, this study has accomplished the following tasks:

- Assessed the accuracy of the RUDI tool in order to see if it was useful in predicting the durations of the R/W acquisition and utility adjustment.
- Identified the duration drivers that need to be considered in predicting durations for R/W acquisition and utility adjustment processes.
- Analyzed associations among accuracy of duration estimation and perception of duration driver importance by practitioners.
- Analyzed associations among practitioners' backgrounds and accuracy of duration estimations / perception of duration driver importance.
- Analyzed the impact of highway project values on shifts between the importance assessments of duration drivers without specific information and the importance of duration drivers with such information upon highway project values.

The research hypotheses established in Chapter 1 follow for review.

Hypothesis 1: The importance of drivers, which are evaluated in forecasting the durations of R/W acquisition and utility adjustment, are perceived differently depending on practitioners' backgrounds, including years of experience, areas of expertise, and types of districts with which practitioners are involved.

To prove this hypothesis, descriptive and inferential statistical approaches such as a chi-square test and a McNemar's test were applied to the data to capture perceptual differences among practitioners in evaluating the importance of drivers.

Hypothesis 2: Practitioners' background areas are positively related to the accuracy of duration estimation for the R/W acquisition and utility adjustment processes. These relationships can be described in the following way:

a) The accuracy of R/W durations estimated by personnel specializing in R/W acquisition is greater than that for the durations predicted by utility adjustment experts.
b) Practitioners with many years of experience are better at predicting durations of R/W acquisition and utility adjustment than personnel with fewer years of experience.

A chi-square test was applied to prove these hypotheses. Thirteen years of experience was designated as the cut-off point to divide practitioners into two groups: least experienced and most experienced. Areas of expertise were divided into R/W acquisition and utility adjustment for the test.

Hypothesis 3: There are differences among More Accurate and Less Accurate practitioners in perceiving the importance of duration drivers needed for the R/W acquisition and utility adjustment processes.

The PRE-application importance of the drivers refers to the assessments practitioners made without specific information about a highway project, and these were examined to prove this hypothesis. A methodology based on the concept of a boxplot was developed to determine the accuracy of estimated durations by practitioners. In order to maximize the efficiency of the methodology, practitioners defined as Moderately Accurate estimators were disregarded for the analysis; only More and Less Accurate estimators were included.

10.2 Conclusions of the Study

In order to apply the conclusions of this study, it is recommended that they should be used carefully because the findings were based on a very limited sample size which is not likely to be statistically representative of all highway projects requiring R/W acquisition and utility adjustment.

1) The Right-of-Way Acquisition and Utility Adjustment Process Duration Information (RUDI) tool has the potential to help highway project planners better forecast the durations needed for acquiring right-of-way and adjusting or relocating utilities involved in highway projects. Specifically, the accuracy of duration estimation appears to be improved when using the RUDI tool as compared to when using personal judgments for determining durations needed in adjusting or relocating utilities.

2) All study participants assessed the following drivers as significant for estimating the durations needed for R/W acquisition and utility adjustment on highway projects. The following drivers were evaluated as having relatively high importance ratings (> 0.8) in the PRE-application importance assessments.

    - Right-of-Way and Utility Scope
    - Status of Environmental Clearance
    - Status of Right-of-Way Map

- Number of Parcels for Acquisition
- Frequency of Eminent Domain
- Need for Residential Relocation
- Number of Utilities Located in Public R/W
- Number of Utilities Located in Private Easement
- Number of Utilities for Adjustments or Relocations
- Responsiveness of Utility Companies to TxDOT Needs

3) The following drivers are the R/W acquisition-related drivers for which More Accurate and Less Accurate estimators differently evaluated their PRE-application importance or upon which both estimators placed significantly more importance. First, the drivers showing large differences (> 0.2) among estimators with different accuracy levels included the following:

    - Dedication of Funds to the Project (R/W and Construction)
    - Level of Local Availability of Replacement Housing Facilities
    - Need for Residential Relocation
    - Funding Limitations for the Project
    - Likelihood of Title Curative Actions
    - TxDOT Project Type
    - District R/W Annual Budget
    - Level of Political Pressure

    Second, both More Accurate and Less Accurate estimators place high importance on the following drivers:

    - Frequency of Eminent Domain

- Status of Environmental Clearance
- Number of Parcels for Acquisition
- Right-of-Way and Utility Scope
- Status of Right-of-Way Map

4) The following drivers are the Utility Adjustment-related drivers for which More Accurate and Less Accurate estimators show considerably different importance ratings or upon which both place significantly high importance ratings.
   First, the four drivers showing large differences (> 0.2) include:

   - Have SUE Investigations been Performed?
   - Funding Limitations for the Project
   - Adjustment is Reimbursable Utility or Non-Reimbursable Utility
   - Dedication of Funds to the Project (R/W and Construction)

   Second, the following drivers are evaluated as having a relatively high importance level (> 0.8) by both More and Less Accurate estimators.

   - Number of Utilities Located in Private Easement
   - Responsiveness of Utility Companies to TxDOT Needs
   - Status of Right-of-Way Map
   - Status of Environmental Clearance
   - Right-of-Way and Utility Scope

5) The following drivers should be considered as important to facilitate better estimates of durations needed for R/W acquisition and utility adjustment. In the RUDI tool, these drivers can be used as key variables that provide duration ranges

represented by percentiles. They are divided into three categories as suggested in this study.

First, drivers related to Project Basic Facts include:

- TxDOT Project Type
- Project Location Type
- TxDOT Highway Type
- Internal R/W Staff Size of a District
- District R/W Annual Budget
- Federally Funded or Non-Federally Funded
- LPA Funded or Non-LPA Funded
- Dedication of Funds to the Project (R/W and Construction)
- Funding Limitations for the Project
- Level of Political Pressure
- Status of Environmental Clearance
- Right-of-Way and Utility Scope
- Status of Right-of-Way Map

Second, drivers related to R/W Acquisition include:

- Number of Parcels for Acquisition
- Need for Residential Relocation
- Likelihood of Title Curative Actions
- Level of Local Availability of Replacement Housing Facilities
- Frequency of Eminent Domain

Third, drivers related to Utility Adjustment include:

- Have SUE Investigations been Performed?
- Adjustment is Reimbursable Utility or Non-Reimbursable Utility
- Utility Type
- Number of Utilities Located in Private Easement
- Responsiveness of Utility Companies to TxDOT Needs

6) This study indicates that there are associations among TxDOT practitioners' backgrounds and their accuracy of duration estimation, although such associations are limited. Three types of strong associations that are statistically important exist and they can be described as follows:
    - Practitioners specializing in R/W acquisition appear to be better in predicting durations needed for R/W acquisition than practitioners with a specialty in utility adjustment.
    - Practitioners with more than 13 years of experience related to R/W acquisition or utility adjustment appear to be more accurate in determining durations for R/W acquisition than practitioners with less than 13 years of experience in these areas.
    - Practitioners involved in urban or metropolitan districts appear to be relatively accurate in estimating durations required for adjusting or relocating utilities as compared to practitioners from rural districts.

7) The findings and knowledge from this study suggest that the real values of drivers that should be considered in predicting durations needed for R/W acquisition and utility adjustment can cause significant shifts in the assessment of driver

importance. However, employing this result should be restricted because there are possible biases caused by the examination of only a single project.

10.3 STUDY CONTRIBUTIONS

Much research previously done regarding R/W acquisition and utility adjustment in highway projects has concentrated on expediting both processes, not predicting the durations during the design phase. Therefore, the designers of the RUDI tool aimed to assist in predicting durations needed for R/W acquisition and utility adjustment on a highway project. As an implementation study of RUDI, this study has made several contributions.

1) This study provided new insights into the types of data that should be collected and contained in future revisions of RUDI for better reliability and applicability. The drivers described above show what types of variables are viewed as more influential by estimators with better predictive accuracy in forecasting durations for R/W acquisition and utility adjustment.

2) This study proposed a comprehensive methodology to identify the principal drivers with high importance practitioners use when predicting durations for R/W acquisition and utility adjustment. The methodology used in formatting these drivers can enable practitioners to investigate the key information needed in estimating necessary durations for R/W acquisition and utility adjustment on highway projects.

3) This study indicated that the usage of an informational tool like RUDI can offer a basis of knowledge upon which both to understand key drivers that should be

considered when forecasting durations for R/W acquisition and utility adjustment and to improve the accuracy of practitioners' duration estimation.

4) This study proposed a systematic framework within which to examine an informational tool for identifying additional needs to facilitate and improve the usage of the tool.

10.4 RECOMMENDATIONS FOR FUTURE RESEARCH

Although the findings from this study are interesting and should be considered in improving the RUDI tool, further studies are required to overcome the limitations caused by the study's limited sample size. The recommendations regarding this study and future research are suggested below.

1) The drivers identified through the course of this study should be re-analyzed using larger sample sizes to increase the reliability of the results pertaining to the estimation of durations of the R/W acquisition and utility adjustment processes. Continued data collection on real highway project can be conducted by periodically updating ROWIS, the database that was used as the main source of data for RUDI.

2) It is important to have a better understanding of how uncertainty and urgency should influence estimators' judgments. If data percentile ranges are retained in future revisions of RUDI, the quantitative relationships between percentiles and schedule urgency and uncertainty need to be better understood.

3) It is necessary to collect more project data to better understand shifts in the assessments of driver importance that occur when estimators learn the values of certain duration drivers although this study articulated the real characteristics of a project that could have a significant impact on changes in the importance of drivers.

4) In order to increase the effectiveness of RUDI as an informational tool and also to overcome its limited applicability stemming from its application to TxDOT projects only, beta-testing RUDI in other state Departments of Transportation is a necessary step. Such testing outside of Texas could be a first step in developing RUDI as an effective informational tool for estimating durations on a wider scale since R/W acquisition and utility adjustment has been considered to be sensitive and problematic by other state DOTs.

Appendix A: TxDOT R/W Acquisition and Utility Adjustment-Related Documents for the Key Milestones in RUDI

A.1: Real Estimate Appraisal Report (R/W-A-5)

Form ROW-A-5
Rev. 3/2004
GSD-EPC

REAL ESTATE APPRAISAL REPORT
TEXAS DEPARTMENT OF TRANSPORTATION

Address of Property:	District:	
Property Owner:	Parcel:	
Address of Property Owner:	CSJ:	
Occupant's Name:	Federal Project No:	
Whole: ☐ Partial: ☐ Acquisition	Highway:	County:

Purpose of the Appraisal

The purpose of this appraisal is to estimate the market value of the fee simple title to the real property to be acquired, encumbered by any easements not to be extinguished, less oil, gas and sulphur. If this acquisition is of less than the whole property, then any special benefits and /or damages to the remainder property must be included in accordance with the laws of Texas.

Market Value

Market value is defined as follows: "Market Value is the price which the property would bring when it is offered for sale by one who desires, but is not obliged to sell, and is bought by one who is under no necessity of buying it, taking into consideration all of the uses to which it is reasonably adaptable and for which it either is or in all reasonable probability will become available within the reasonable future."

Certificate of Appraiser

I hereby certify:

That it is my opinion the total compensation for the acquisition of the herein described property is $ as of , based upon my independent appraisal and the exercise of my professional judgment;

That on (date)(s), I personally inspected in the field the property herein appraised; that I afforded , the property owner or the representative of the property owner, the opportunity to accompany me at the time of the inspection; type comment here or delete this field;

That the comparables relied upon in making said appraisal were as represented by the photographs contained in the appraisal report and were inspected on (date)(s);

That I have not revealed and will not reveal the findings and results of such appraisal to anyone other than the proper officials of the Texas Department of Transportation or officials of the Federal Highway Administration until authorized by State officials to do so, or until I am required to do so by due process of law, or until I am released from this obligation by having publicly testified to such findings;

That my compensation is not contingent upon the reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value estimate, the attainment of a stipulated result, or the occurrence of a subsequent event.

I certify to the best of my knowledge and belief:

That the statements of fact contained in this report are true and correct;

That the reported analyses, opinions and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, unbiased professional analyses, opinions, and conclusions;

That I have no present or prospective interest in the property that is the subject of this report, and I have no personal interest or bias with respect to the parties involved;

That my analyses, opinions and conclusions were developed, and this report has been prepared in conformity with the appropriate State laws, regulations, and policies and procedures applicable to the appraisal of right of way for such purposes, and that to the best of my knowledge no portion of the value assigned to such property consists of items which are noncompensable under the established law of said State, and any decrease or increase in the fair market value of subject real property prior to the date of valuation caused by the public improvement for which such property is to be acquired, or by the likelihood that the property would be acquired for such improvement, other than that due to the physical deterioration within the reasonable control of the owner, has been disregarded in estimating the compensation for the property.

Appraiser Signature

Certification Number

Date

To the best of my knowledge, the value does not include any items which are not compensable under State law.

District Reviewing Appraiser Date

Page 1

Form ROW-A-5
Rev. 3/2004

PHOTOGRAPHS OF SUBJECT PROPERTY
Include Each Major Improvement

Parcel No.:	Local Address:
Date Taken:	Taken By:
1. Point from which taken:	Looking:

Highlight this text and insert photo here

2. Point from which taken:	Looking:

Highlight this text and insert photo here

Page 2.

Form ROW-A-5
Rev. 3/2004

PROPERTY VALUATION SUMMARY

Whole: ☐ Part to be Acquired: ☐ Remainder After: ☐

HIGHEST AND BEST USE ANALYSIS: (The *Highest and Best Use* analysis should consider the reasonably probable and legal use of vacant land or improved property considering legally permissible, physically possible, financially feasible, and maximally productive. Use separate page, numbered accordingly, as necessary.)

VALUATION APPROACHES
Insert value estimate, then describe, analyze, and support each approach as required.

Cost Approach...$

Sales Comparison Approach..$

Income Approach...$

Reconciliation of Approaches to Value:

Contributory Value of Improvements (Itemized)	
	$
	$
	$
	$
	$
	$
	$
	$
	$
	$
Total Contributory Value of Improvements	$

Easement Value..... acres/sq. ft. @ $ = $
Land Value........... acres/sq. ft. @ $ = $

Reconciled Final Value .... $

Each approach developed follows this page and is sequenced as shown below.

Land Value, pg	Cost Approach, pg	Sales Comparison Approach, pg	Income Approach, pg

Form ROW-A-5
Rev. 3/2004

SALES COMPARISON APPROACH Whole: ☐ Part to be Acquired: ☐ Remainder After: ☐
Land: ☐ Improved: ☐

VALUATION GRID		Representative Comparable Sales		
	Subject	**Comp. No.**	**Comp. No.**	**Comp. No.**
Grantor				
Grantee				
Date of Sale				
Unit Price				
Relative Location				
Financing				
Conditions of Sale				
Market Conditions				
Physical Characteristics				
	Indicated Unit Value	$	$	$
Estimated Unit Value				$

Estimated Value by Sales Comparison Approach ....$

Explanation of Adjustments with Reconciliation (*Attach Comparable Data Supplement and Map;* use separate page, numbered accordingly, as necessary.):

Page SCA -

Form ROW-A-5
Rev. 3/2004

COST APPROACH Whole: ☐ Part to be Acquired: ☐ Remainder After: ☐

Estimated Replacement/ Reproduction Cost					
Improvement	**Number of sq ft**	**$ per sq ft**	**Cost New**	**<Depreciation**	**Value**
Main Building					$
Other					$
Contributory Value of the Buildings					$
Accessory Improvements					
					$
					$
					$
Contributory Value of the Accessory Improvements					$
Site Improvements					
Paving					$
Fencing (l.f.)					$
Landscaping					$
Other					$
					$
					$
					$
					$
					$
Contributory Value of the Site Improvements					$
Contributory Value of all Improvements					$
Land Value					$
Estimated Value by Cost Approach					$

Furnish sources of cost data and support for depreciation factors (physical, functional, and economic. Use separate page, numbered accordingly, as necessary.):

Page CA -

Form ROW-A-5
Rev. 3/2004

INCOME APPROACH Whole: ☐ Part to be Acquired: ☐ Remainder After: ☐

Potential Gross Income	....	$				
Vacancy	%	$				
Effective Gross Income	....				$	
Expenses:						
Fixed Taxes		$				
Insurance		$				
Variable Management		$				
Other		$				
		$				
		$				
Total Expenses	....				$	
Net Operating Income	....				$	
Income Capitalized @		%	....		$	
Plus: Value of Excess Land (if any)			....		$	
					$	
Estimated Value by Income Approach			....		$	

Furnish supporting information/data, justification of gross income estimates, expenses, method of capitalization and capitalization rate (*Attach Comparable Rental Data Supplement and Map.* Use separate page, numbered accordingly, as necessary.):

Page IA -

PART TO BE ACQUIRED

Highest and Best Use (Use separate page, numbered accordingly, as necessary):

Contributory Value of Improvements (Itemized)							
						$	
						$	
						$	
						$	
						$	
						$	
Total Contributory Value of Improvements						$	
Easement	ac/sf	@$		$			
Fee	ac/sf	@$		$			
Total Land						$	
TOTAL VALUE AS A UNIT						**$**	

REMAINDER BEFORE THE ACQUISITION

Contributory Value of Improvements (Itemized)							
						$	
						$	
						$	
						$	
						$	
						$	
Total Contributory Value of Improvements						$	
Easement	ac/sf	@$		$			
Fee	ac/sf	@$		$			
Total Land						$	
TOTAL AS A UNIT						**$**	

Form ROW-A-5
Rev. 3/2004

PROPERTY VALUATION SUMMARY

Whole: ☐ Part to be Acquired: ☐ Remainder After: ☐

HIGHEST AND BEST USE ANALYSIS: (The *Highest and Best Use* analysis should consider the reasonably probable and legal use of vacant land or improved property considering legally permissible, physically possible, financially feasible, and maximally productive. Use separate page, numbered accordingly, as necessary.)

VALUATION APPROACHES
Insert value estimate, then describe, analyze, and support each approach as required.

Cost Approach..$

Sales Comparison Approach...$

Income Approach..$

Reconciliation of Approaches to Value:

Contributory Value of Improvements (Itemized)	
	$
	$
	$
	$
	$
	$
	$
	$
	$
	$
Total Contributory Value of Improvements	$

Easement Value.... acres/sq. ft. @ $ = $
Land Value........... acres/sq. ft. @ $ = $

Reconciled Final Value .... $

Each approach developed follows this page and is sequenced as shown below.

Land Value, pg	Cost Approach, pg	Sales Comparison Approach, pg	Income Approach, pg

EXPLANATION OF DAMAGES (if any):

COMPENSATION SUMMARY

WHOLE PROPERTY:
The market value of the whole property is......................................… … … … …..$

PART TO BE ACQUIRED:
Considered as severed land, the fee simple title to the part being acquired
for highway purposes (less oil, gas and sulphur and subject to existing easements,
if any, which are not to be extinguished) is...… … … … … .$

REMAINING PROPERTY:
The value of the remainder immediately before the taking is.........… … … … …...$
Considering the uses to which the part taken is to be subjected
to, the market value of the remainder immediately after
the acquisition is..… … … … …..$

NET DAMAGES OR ENHANCEMENTS, if any...… … … … … .$

.... $

TOTAL COMPENSATION...… … … … ….$

A.2: REAL ESTIMATE APPRAISAL REPORT (R/W-A-6)

ROW-A-6
Rev. 7/2004
GSD-EPC
Page 1 of 5

REAL ESTATE APPRAISAL REPORT
TEXAS DEPARTMENT OF TRANSPORTATION

Address of Property:	District:	
Property Owner:	ROW CSJ:	
Address of Property Owner:	Parcel:	
Occupant's Name:	Federal Project No:	
Whole: ☐ Partial: ☐ Acquisition	Highway:	County:

Purpose of the Appraisal

The purpose of this appraisal is to estimate the market value of the fee simple title to the real property to be acquired, encumbered by any easements not to be extinguished, less oil, gas and sulphur. If this acquisition is of less than the whole property, then any special benefits and/or damages to the remainder property must be included in accordance with the laws of Texas.

Market Value

Market value is defined as follows: "Market Value is the price which the property would bring when it is offered for sale by one who desires, but is not obliged to sell, and is bought by one who is under no necessity of buying it, taking into consideration all of the uses to which it is reasonably adaptable and for which it either is or in all reasonable probability will become available within the reasonable future."

Certificate of Appraiser

I hereby certify that , it is my opinion the total compensation for the acquisition of the herein described property is $ as of , based upon my independent appraisal and the exercise of my professional judgment; on (date)(s), I personally inspected in the field the property herein appraised; I afforded , the property owner or the representative of the property owner, the opportunity to accompany me at the time of the inspection you may type a comment here or delete this field; the comparables relied upon in making said appraisal were as represented by the photographs contained in the appraisal report and were inspected on (date)(s); I have not revealed and will not reveal the findings and results of such appraisal to anyone other than the proper officials of the Texas Department of Transportation or officials of the Federal Highway Administration until authorized by State officials to do so, or until I am required to do so by due process of law or until I am released from this obligation by having publicly testified to such findings; and , my compensation is not contingent upon the reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value estimate, the attainment of a stipulated result or the occurrence of a subsequent event.

I certify to the best of my knowledge and belief that the statements of fact contained in this report are true and correct; the reported analyses, opinions and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, unbiased professional analyses, opinions and conclusions; I have no present or prospective interest in the property that is the subject of this report, and I have no personal interest or bias with respect to the parties involved; and, my analyses, opinions and conclusions were developed, and this report has been prepared in conformity with the appropriate State laws, regulations, and policies and procedures applicable to the appraisal of right of way for such purposes, and that to the best of my knowledge no portion of the value assigned to such property consists of items which are noncompensable under the established law of said State, and any decrease or increase in the fair market value of subject real property prior to the date of valuation caused by the public improvement other than that due to the physical deterioration within the reasonable control of the owner has been disregarded in estimating the compensation for the property.

Appraiser Signature

Certification Number

Date

To the best of my knowledge, the value does not include any items which are not compensable under State law.

District Reviewing Appraiser Date

PHOTOGRAPHS OF SUBJECT PROPERTY
Include Each Major Improvement

Parcel No.:	Local Address:
Date Taken:	Taken By:
1. Point from which taken:	Looking:

Highlight this text and insert photo here

2. Point from which taken:	Looking:

Highlight this text and insert photo here

DESCRIPTION OF PROPERTY:

AREA OR NEIGHBORHOOD ANALYSIS:

SITE ANALYSIS - (Attach Parcel Sketch)

Five Year Sales History:
Legal Description:
Improvements:

HIGHEST AND BEST USE ANALYSIS:

VALUATION OF PART TO BE ACQUIRED

LAND VALUATION
Representative Comparable Sales

	Subject	Comp. No.	Comp. No.	Comp. No.
Grantor				
Grantee				
Date				
Unit Price				
Relative Location				
Conditions of Sale				
Date of Sale				
Location				
Indicated Unit Value	$	$	$	$

Explanation of Adjustments with Reconciliation:

ESTIMATED VALUE OF ACQUISITION

Land:	(acre/sf) @ $	per acre/sf		$
Improvements:			$	
			$	
			$	
			$	
			$	

TOTAL ESTIMATED VALUE.. $

Cost to Cure Damages .... $

Estimated Total Compensation.. $

Furnish comments on attachments as necessary.

A.3: Title Company's Closing Statement (R/W-N-72)

ROW-N-72
Rev. 3/2004
Replaces Form D-15-72, all pages
GSD-EPC
Page 1 of 2

TITLE COMPANY'S CLOSING STATEMENT - STATE OF TEXAS

Title Company:

County:
District:
ROW CSJ No.:

G.F. No.:
Date:

Parcel Number:
Federal Project No.:

State Warrant No.: $

SELLER:

CLOSING AND TITLE EXPENSES	SELLER	STATE
Title Policy:	$	$
Recording Fees:		
Deed - paid to County Clerk		$
Release - paid to County Clerk	$	$
Quitclaim Deed -paid to County Clerk	$	$
Seller's Attorney's Fees paid to:	$	$
Taxes:		
Delinquent - paid to County Tax Collector	$	
paid to	$	
Current - paid to	$	
Additional services rendered including furnishing preliminary title information and preparation and completion of forms not covered by title insurance rates approved by the State Board of Insurance		
Notes, etc., paid to: (Title Company Administrative Fee)		$
	$	
	$	
Net Amount paid to Seller	$	
Total Disbursements by Title Company	$	
Amount Charged to State	$	$

WE APPROVE AND ACCEPT ABOVE STATEMENT CORRECT:	I CERTIFY THE ABOVE TO BE TRUE AND AS OUR INTEREST MAY APPEAR:
Seller: ______________________________	______________________________ (Underwriter)
______________________________	By:______________________________ (Agent for Underwriter)
______________________________	By:______________________________ (Authorized Signature & Title)
______________________________	Date: ______________________________

State Right of Way Closing Certificate

I certify that the State's warrant was disbursed as set forth above and the deed has been delivered to the County Clerk for recording.

____
Signature

____
Title

A.4: TITLE COMPANY'S CLOSING STATEMENT (R/W-E-ND)

ROW-E-ND
Rev. 3/2004
GSD-EPC
Page 1 of 2

District:
ROW CSJ No.:
Parcel No.:
Voucher No.:

NOTICE OF DEPOSIT

NO.

STATE OF TEXAS	§	**CONDEMNATION PROCEEDING**
	§	**IN THE**
VS.	§	
	§	**OF**
	§	
	§	**COUNTY, TEXAS**
	§	

TO:

NOTICE IS HEREBY GIVEN:

1. That the Award of Commissioners in the captioned matter has been filed with the judge in this proceeding, in which the amount of damages awarded against the State of Texas by the Commissioners is Dollars ($).
2. That the State of Texas desires to enter upon and take possession of the property sought to be condemned in this proceeding pending litigation, and in order to do so, deposits this amount in Court by delivering to the Clerk of this Court the following described State Comptroller of Public Accounts Warrant in the amount described above, to wit: Treasury Warrant No. .
3. That, by reason of this deposit, the State of Texas is now entitled to enter upon and take possession of said property.
4. That all parties asserting a claim to all or part of this amount may make written application to the judge of this court seeking disbursement of such sum, and may request a hearing on such application, subject to notice and time requirements as set forth in Rules 21 and 21a of the Texas Rules of Civil Procedure.

TEXAS DEPARTMENT OF TRANSPORTATION

BY: ______________________________

Name: ______________________________

Title: ______________________________

CERTIFICATE OF SERVICE

The State of Texas, acting herein by and through the Texas Department of Transportation, hereby certifies that on a true copy of the above Notice of Deposit was served upon the parties identified below, or their attorney of record so stated, in the manner stated and to the address or telecopier number following each named party or attorney of record, as follows:

TEXAS DEPARTMENT OF TRANSPORTATION

BY: ________________________________ (Signature)

Name:

Title: ________________________________

Address:

Telephone:

A.5: STANDARD UTILITY AGREEMENT (U-35)

Form ROW-U-35
Rev. 1/2007
GSD-EPC
Page 1

STANDARD UTILITY AGREEMENT

	U-Number:
District:	County:
Federal Project No.:	Highway:
ROW CSJ:	From:
Highway Project Letting Date:	To:

This Agreement by and between the State of Texas, acting by and through the Texas Transportation Commission, (**"State**"), and , ("**Utility**"), acting by and through its duly authorized representative, shall be effective on the date of approval and execution by and on behalf of the **State**.

WHEREAS, the **State** has deemed it necessary to make certain highway improvements as designated by the **State** and approved by the Federal Highway Administration within the limits of the highway as indicated above;

WHEREAS, the proposed highway improvements will necessitate the adjustment, removal, and/or relocation of certain facilities of **Utility** as indicated in the following statement of work: [Enter scope of work here or submission will not be complete] ; and more specifically shown in **Utility's** plans, specifications and estimated costs, which are attached hereto as Attachment "A".

WHEREAS, the **State** will participate in the costs of the adjustment, removal, and/or relocation of certain facilities to the extent as may be eligible for State and/or Federal participation.

WHEREAS, the **State,** upon receipt of evidence it deems sufficient, acknowledges **Utility's** interest in certain lands and/or facilities that entitle it to reimbursement for the adjustment, removal, and relocation of certain of its facilities located upon the lands as indicated in the statement of work above.

NOW, THEREFORE, BE IT AGREED:

The **State** will pay to **Utility** the costs incurred in adjustment, removal, and/or relocation of **Utility's** facilities up to the amount said costs may be eligible for **State** participation.

The **State** and **Utility** agree that all conduct under this agreement, including but not limited to the adjustment, removal and relocation of the facility, the development and reimbursement of costs, any environmental requirements, and retention of records will be in accordance with 23 CFR 645, Subparts A & B and all other applicable federal and state laws, rules and regulations. **Utility** agrees to supply, upon request by the **State**, proof of compliance with the aforementioned laws, rules and regulations prior to the commencement of construction.

The **Utility** agrees to develop relocation or adjustment costs by accumulating actual direct and related indirect costs in accordance with a work order accounting procedure prescribed by **State**, or may, with the **State's** approval, accumulate actual direct and related indirect costs in accordance with an established accounting procedure developed by **Utility**. Bills for work hereunder will be submitted to **State** not later than 90 days after completion of the work.

When requested, the **State** will make intermediate payments at not less than monthly intervals to **Utility** when properly billed and such payments will not exceed 80 percent (80%) of the eligible cost as shown in each such billing. In addition, the **State** will make a payment, before audit, which will bring the total percentage paid to the **Utility** up to the 90% eligible cost. Intermediate payments shall not be construed as final payment for any items included in the intermediate payment.

_____ ________
Initial Date

Alternatively, **State** agrees to pay **Utility** an agreed lump sum of $ as supported by the attached estimated costs. The **State** will, upon satisfactory completion of the adjustments, removals, and/or relocations and upon receipt of a final billing, make payment to **Utility** in the agreed amount.

Upon execution of this agreement by both parties hereto, the **State** will, by written notice, authorize the **Utility** to perform such work diligently, and to conclude said adjustment, removal, or relocation by the stated completion date. The completion date shall be extended for delays caused by events outside **Utility's** control, including an event of Force Majeure, which shall include a strike, war or act of war (whether an actual declaration of war is made or not), insurrection, riot, act of public enemy, accident, fire, flood or other act of God, sabotage, or other events, interference by the **State** or any other party with **Utility's** ability to proceed with the relocation, or any other event in which **Utility** has exercised all due care in the prevention thereof so that the causes or other events are beyond the control and without the fault or negligence of **Utility**.

The **State** will, upon satisfactory completion of the relocation or adjustment and upon receipt of final billing prepared in an approved form and manner, make payment in the amount of 90 percent (90%) of the eligible costs as shown in the final billing prior to audit and after such audit shall make an additional final payment totaling the reimbursement amount found eligible for **State** reimbursement.

Unless an item below is stricken and initialed by the **State and Utility**, this agreement in its entirety consists of the following:

1. Standard Utility Agreement;
2. Plans, Specifications, and Estimated Costs (Attachment “A”);
3. Utility’s Accounting Method (Attachment “B”);
4. Utility’s Schedule of Work and Estimated Date of Completion (Attachment “C”);
5. Statement Covering Contract Work – ROW-U-48 (Attachment “D”);
6. Eligibility Ratio (Attachment “F”);
7. Betterment Calculation and Estimates (Attachment “G”);
8. Proof of Property Interest – ROW-U-1A, ROW-U-1B, or ROW-U-1C (Attachment “H”);
9. Inclusion in Highway Construction Contract (if applicable) (Attachment “I”); and
10. Utility Joint Use Acknowledgment – ROW -U-JUA (Attachment “E”).

All attachments are included herein as if fully set forth. In the event it is determined that a substantial change from the statement of work contained in this agreement is required, reimbursement therefore shall be limited to costs covered by a modification or amendment of this agreement or a written change or extra work order approved by the **State and Utility**.

This agreement is subject to cancellation by the **State** at any time up to the date that work under this agreement has been authorized and that such cancellation will not create any liability on the part of the **State.**

The State Auditor may conduct an audit or investigation of any entity receiving funds from the **State** directly under this contract or indirectly through a subcontract under this contract. Acceptance of funds directly under this contract or indirectly through a subcontract under this contract acts as acceptance of the authority of the State Auditor, under the direction of the Legislative Audit Committee, to conduct an audit or investigation in connection with those funds. An entity that is the subject of an audit or investigation must provide the state auditor with access to any information the state auditor considers relevant to the investigation or audit.

The **Utility** by execution of this agreement does not waive any of the rights which **Utility** may have within the limits of the law.

It is expressly understood that the **Utility** conducts the adjustment, removal, or relocation at its own risk, and that TxDOT makes no warranties or representations regarding the existence or location of utilities currently within its right of way.

The signatories to this agreement warrant that each has the authority to enter into this agreement on behalf of the party represented.

_____ ________
Initial Date

UTILITY

Utility: ______________________________
Name of Utility

By: ______________________________
Authorized Signature

____
Print or Type Name

Title: ______________________________

Date: ______________________________

EXECUTION RECOMMENDED:

____
, District *

THE STATE OF TEXAS

Executed and approved for the Texas Transportation Commission for the purpose and effect of activating and/or carrying out the orders, established policies or work programs heretofore approved and authorized by the Texas Transportation Commission.

By: ______________________________

______________________________ **

Date: ______________________________

* For locally-executed agreements, ROW Administrator recommends execution; otherwise District Engineer (or designee) .
** For locally-executed agreements, District Engineer (or designee) approves and executes; otherwise ROW Division Director.

_____ ________
Initial Date

ATTACHMENT "I"

(to be used only for Inclusion in Highway Construction Contract)

In the best interest of both the **State** and the **Utility**, the **Utility** requests the **State** to include the plans and specifications for this work in the general contract for construction of Highway   in this area, so that the work can be coordinated with the other construction operations; and the construction contract is to be awarded by the **State** to the lowest qualified bidder who submits a proposal in conformity with the requirements and specifications for the work to be performed.

Utility: ____
Name of Utility

By: ____
Authorized Signature

____
Print or Type Name

Title: ____

Date: ____

_____ ________
Initial Date

A.6: UTILITY CLEARANCE LETTER (R/W-U-CLEARANCE)

Form ROW-U-CLEARANCE
(12/2006)
Previous revisions obsolete
GSD-EPC
Page 1

UTILITY CLEARANCE LETTER

U-Number:

District:	County:
Construction CSJ:	Highway:
ROW CSJ:	From:
Projected Highway Letting Date:	To:

The purpose of this Utility Clearance Letter is to inform **State** of the anticipated dates by which **Utility's** facilities that are in conflict with the above project limits will be adjusted. The dates below assume that the **State** has acquired all necessary right-of-way for the project, that sufficient plans indicating the proposed highway improvements have been submitted to **Utility**, and that design changes necessitating material utility facility redesign do not occur.

Utility Company: ______________________________

Anticipated Construction Start Date: ______________________________

Anticipated Duration of Construction: ______________________________

Anticipated Construction Completion Date: ______________________________

The information provided above is strictly an estimate and is provided to **State** solely for **State's** planning purposes. This letter is not intended to create any legally binding commitments on either **Utility** or **State,** nor to waive any rights **Utility** or **State** might otherwise possess.

If there is a conflict between prior submitted dates and those shown in this letter, the dates set forth above should be used for **State's** planning purposes.

______________________________ ______________________
Authorized Utility Representative Date

Appendix B: Model Project Description Form

B.1: MODEL PROJECT DESCRIPTION FORM

MODEL PROJECT DESCRIPTION FORM

Project Basic Facts	
Driver	**Value**
1. ☐ TxDOT Project Type	☐ RER (Rehabilitation of Existing Road) ☐ UGN (Upgrade to Standards Non-Freeway) ☐ NNF (New Location Non-Freeway) ☐ INC (Interchange - New or Reconstructed) ☐ WF (Widen Freeway) ☐ WNF (Widen Non-Freeway) ☐ BR (Bridge Replacement) ☐ CNF (Convert Non-Freeway to Freeway) ☐ HES (Hazard Elimination/Safety) ☐ MSC (Miscellaneous) ☐ NLF (New Location Freeway) ☐ OV (Overlay) ☐ UPG (Upgrade to Standards ☐ BWR (Bridge Widening/Repair)
2. ☐ TxDOT Highway Type	☐ IH (Interstate) ☐ SH (State Highway) ☐ FM (Farm to Market road) ☐ CS (City Street) ☐ US (US highway) ☐ RM (Ranch to Market road)
3. ☐ Project Location Type	☐ Urban ☐ Rural ☐ Metropolitan
4. ☐ Right-of-Way and Utility Scope	☐ Only R/W acquisition ☐ Only Utility adjustment ☐ Both R/W acquisition and Utility adjustment
5. ☐ Status of Schematic Design	☐ Completed ☐ In-progress ☐ Not Started
6. ☐ Status of Boundary Surveying	☐ Completed ☐ In-progress ☐ Not Started
7. ☐ Status of Environmental Clearance	☐ Completed ☐ In-progress ☐ Not Started
8. ☐ Status of Right-of-Way Map	☐ Completed ☐ In-progress ☐ Not Started

9. ☐ Internal R/W Staff Size of a District	☐ Less than 9 FTEs ☐ 9 or more than 9 FTEs
10. ☐ District R/W Annual Budget	☐ Less than $6million ☐ More than $6million
11. ☐ Dedication of Funds to the Project (R/W and Construction)	☐ Yes ☐ No ☐ Unknown
12. ☐ LPA Funded or Non-LPA Funded	☐ LPA funded ☐ Non-LPA funded
13. ☐ Federally Funded or Non-Federally Funded	☐ Federally funded ☐ Non-Federally funded
14. ☐ Funding Limitations for the Project	☐ LPA or Utility Company needing an SIB loan ☐ Partial payments from funding ☐ Time required to fund the project ☐ Other ____________ ☐ None
15. ☐ Level of Acceptance of the Project by the Public	☐ Extensive supportive ☐ Not supportive ☐ Mixed
16. ☐ Level of Political Pressure	☐ Extensive ☐ Moderate ☐ Minimal
17. ☐ Common Concerns of Property Owners	☐ Access ☐ Safety ☐ Project duration ☐ Compensation ☐ Other ____________
18. ☐ Current Status of the R/W Project	☐ Request R/W CSJ ☐ Request R/W full release ☐ Assigned R/W CSJ ☐ R/W full release ☐ Pending release
Right of Way Acquisition	
Driver	**Value**
19. ☐ Number of Parcels for Acquisition	☐ Less than 10 ☐ 10 to 30 ☐ More than 30

20. ☐ Different Types of Parcel Usages	☐ Vacant ☐ Residential ☐ Commercial ☐ Agricultural ☐ Religious facility ☐ Parking lot ☐ Other ________________ ☐ Unknown
21. ☐ Frequency of Eminent Domain	☐ Several ☐ Some ☐ None ☐ Unknown
22. ☐ Source of Personnel to be used for R/W Acquisition	☐ Outsourced ☐ District staff ☐ Unknown
23. ☐ Availability of District R/W Appraisers (District Staff and Outsourced)	☐ Adequate ☐ Marginally adequate ☐ Inadequate
24. ☐ Is Funding Available for Outsourcing Staff Assistance?	☐ Yes ☐ No ☐ Unknown
25. ☐ Type of Property Owners	☐ All in-state ☐ Some out-of-state ☐ Unknown
26. ☐ Level of Familiarity with Key Landowners	☐ High ☐ Low ☐ Unknown
27. ☐ Are There Any Property Tenants to Consider?	☐ Yes ☐ No ☐ Unknown
28. ☐ Need for Residential Relocation	☐ Substantial ☐ Some ☐ None
29. ☐ Level of Local Availability of Replacement Housing Facilities	☐ High ☐ Medium ☐ Low ☐ Unknown
30. ☐ Need for Business Relocation	☐ Substantial ☐ Some ☐ None
31. ☐ Level of Local Availability of Replacement Business Facilities	☐ High ☐ Medium ☐ Low ☐ Unknown
32. ☐ Likelihood of Title Curative Actions	☐ High ☐ Medium ☐ Low ☐ Unknown

33. ☐ Responsiveness of Local Title Companies to TxDOT	☐ High ☐ Medium ☐ Low ☐ Unknown
Utility Adjustment	
Driver	**Value**
34. ☐ Have SUE Investigations Been Performed?	☐ Yes ☐ No ☐ Unknown
35. ☐ Will SUE Investigations Be Performed? (If no or unknown in the driver # 34)	☐ Yes ☐ No ☐ Unknown
36. ☐ Utility Type	☐ Overhead power ☐ Buried power ☐ Waste water ☐ Water ☐ Underground communication ☐ Overhead communication ☐ Gas ☐ Other ____________ ☐ Unknown
37. ☐ Number of Utilities Located in Public R/W	☐ Less than 4 ☐ 4 to 7 ☐ More than 7 ☐ Unknown
38. ☐ Number of Utilities Located in Private Easement	☐ Less than 4 ☐ 4 to 7 ☐ More than 7 ☐ Unknown
39. ☐ Number of Utilities for Adjustments or Relocations	☐ Less than 4 ☐ 4 to 7 ☐ More than 7 ☐ Unknown
40. ☐ Is there any Utility Adjustment to be Included in the Highway Construction Contract?	☐ Yes ☐ No ☐ Unknown
41. ☐ Responsiveness of Utility Companies to TxDOT Needs	☐ High ☐ Medium ☐ Low ☐ Unknown
42. ☐ Adjustment is Reimbursable Utility or Non-Reimbursable Utility	☐ Reimbursable ☐ Non-reimbursable ☐ Unknown

Appendix C: Description Forms of Model Projects A, B, and C

C.1: MODEL PROJECT (A) DESCRIPTION FORM

MODEL PROJECT (A) DESCRIPTION FORM

Project Basic Facts	
Driver	**Value**
1. ☐ TxDOT Project Type	☐ RER (Rehabilitation of Existing Road) ☐ UGN (Upgrade to Standards Non-Freeway) ☐ NNF (New Location Non-Freeway) ☐ INC (Interchange - New or Reconstructed) ☑ WF (Widen Freeway) ☐ WNF (Widen Non-Freeway) ☐ BR (Bridge Replacement) ☐ CNF (Convert Non-Freeway to Freeway) ☐ HES (Hazard Elimination/Safety) ☐ MSC (Miscellaneous) ☐ NLF (New Location Freeway) ☐ OV (Overlay) ☐ UPG (Upgrade to Standards ☐ BWR (Bridge Widening/Repair)
2. ☐ TxDOT Highway Type	☑ IH (Interstate) ☐ SH (State Highway) ☐ FM (Farm to Market road) ☐ CS (City Street) ☐ US (US highway) ☐ RM (Ranch to Market road)
3. ☐ Project Location Type	☐ Urban ☐ Rural ☑ Metropolitan
4. ☐ Right of Way and Utility Scope	☐ Only R/W acquisition ☐ Only Utility adjustment ☑ Both R/W acquisition and Utility adjustment
5. ☐ Status of Schematic design	☑ Completed ☐ In-progress ☐ Not Started
6. ☐ Status of Boundary Surveying	☑ Completed ☐ In-progress ☐ Not Started

1

7. ☐ Status of Environmental Clearances	☑ Completed ☐ In-progress ☐ Not Started
8. ☐ Status of Right of Way Map	☑ Completed ☐ In-progress ☐ Not Started
9. ☐ Internal R/W Staff Size of a District	☐ Less than 9 FTEs ☑ 9 or more than 9 FTEs
10. ☐ District R/W Annual Budget	☐ Less than $6million ☑ More than $6million
11. ☐ Dedication of Funds to the Project (R/W and Construction)	☑ Yes ☐ No ☐ Unknown
12. ☐ LPA Funded or Non-LPA Funded	☐ LPA funded ☑ Non-LPA funded
13. ☐ Federally Funded or Non-Federally Funded	☑ Federally funded ☐ Non-Federally funded
14. ☐ Funding Limitations for the Project	☐ LPA or Utility Company needing an SIB loan ☐ Partial payments from funding participants ☐ Time required to fund the project ☐ Other ________________ ☑ None
15. ☐ Level of Acceptance of the Project by the Public	☑ Extensive supportive ☐ Not supportive ☐ Mixed
16. ☐ Level of Political Pressure	☐ Extensive ☑ Moderate ☐ Minimal
17. ☐ Common Concerns of Property Owners	☑ Access ☐ Safety ☑ Project duration ☐ Compensation ☐ Other ________________
18. ☐ Current Status of the R/W Project	☐ Request R/W CSJ ☐ Request R/W full release ☐ Assigned R/W CSJ ☑ R/W full release ☐ Pending release

Right of Way Acquisition	
Driver	**Value**
19. ☐ Number of Parcels for Acquisition	☐ Less than 10 ☑ 10 to 30 ☐ More than 30
20. ☐ Different Types of Parcel Usages	☑ Vacant ☑ Residential ☑ Commercial ☐ Agricultural ☐ Religious facility ☑ Parking lot ☐ Other ____________
21. ☐ Frequency of Eminent Domain Acquisition	☑ Several ☐ Some ☐ None ☐ Unknown
22. ☐ Source of Personnel to be used for R/W Acquisition	☐ Outsourced ☐ District staff ☑ Unknown
23. ☐ Availability of District R/W Appraisers (District Staff and Outsourced)	☑ Adequate ☐ Marginally adequate ☐ Inadequate
24. ☐ Is Funding Available for Outsourcing Staff Assistance?	☑ Yes ☐ No ☐ Unknown
25. ☐ Type of Property Owners	☐ All in-state ☑ Some out-of-state ☐ Unknown
26. ☐ Level of Familiarity with Key Landowners	☐ High ☑ Low ☐ Unknown
27. ☐ Are There Any Property Tenants to Consider?	☐ Yes ☑ No ☐ Unknown
28. ☐ Need for Residential Relocation	☑ Substantial ☐ Some ☐ None
29. ☐ Level of Local Availability of Replacement Housing Facilities	☑ High ☐ Medium ☐ Low ☐ Unknown
30. ☐ Need for Business Relocation	☑ Substantial ☐ Some ☐ None

31. ☐ Level of Local Availability of Replacement Business Facilities	☑ High ☐ Medium ☐ Low ☐ Unknown
32. ☐ Likelihood of Title Curative Actions	☑ High ☐ Medium ☐ Low ☐ Unknown
33. ☐ Responsiveness of Local Title Companies to TxDOT	☑ High ☐ Medium ☐ Low ☐ Unknown
Utility Adjustment	
Driver	**Value**
34. ☐ Have SUE Investigations Been Performed?	☑ Yes ☐ No ☐ Unknown
35. ☐ Will SUE Investigations Be Performed? (If no or unknown in the driver # 34)	☐ Yes ☐ No ☐ Unknown
36. ☐ Utility Type	☑ Overhead power ☑ Buried power ☑ Waste water ☑ Water ☑ Underground communication ☑ Overhead communication ☑ Gas
37. ☐ Number of Utilities Located in Public R/W	☐ Less than 4 ☐ 4 to 7 ☐ More than 7 ☑ Unknown
38. ☐ Number of Utilities Located in Private Easement	☐ Less than 4 ☐ 4 to 7 ☐ More than 7 ☑ Unknown
39. ☐ Number of Utilities for Adjustments or Relocations	☐ Less than 4 ☐ 4 to 7 ☐ More than 7 ☑ Unknown
40. ☐ Is There Any Utility Adjustment to be Included in the Highway Construction Contract?	☑ Yes ☐ No ☐ Unknown
41. ☐ Responsiveness of Utility Companies to TxDOT	☑ High ☐ Medium ☐ Low

Needs	☐ Unknown
42. ☐ Adjustment is Reimbursable Utility or Non-Reimbursable Utility	☑ Reimbursable ☑ Non-reimbursable ☐ Unknown

C.2: Model Project (B) Description Form

MODEL PROJECT (B) DESCRIPTION FORM

Project Basic Facts	
Driver	**Value**
1. ☐ TxDOT Project Type	☑ RER (Rehabilitation of Existing Road) ☐ UGN (Upgrade to Standards Non-Freeway) ☐ NNF (New Location Non-Freeway) ☐ INC (Interchange - New or Reconstructed) ☐ WF (Widen Freeway) ☐ WNF (Widen Non-Freeway) ☐ BR (Bridge Replacement) ☐ CNF (Convert Non-Freeway to Freeway) ☐ HES (Hazard Elimination/Safety) ☐ MSC (Miscellaneous) ☐ NLF (New Location Freeway) ☐ OV (Overlay) ☐ UPG (Upgrade to Standards ☐ BWR (Bridge Widening/Repair)
2. ☐ TxDOT Highway Type	☐ IH (Interstate) ☐ SH (State Highway) ☑ FM (Farm to Market road) ☐ CS (City Street) ☐ US (US highway) ☐ RM (Ranch to Market road)
3. ☐ Project Location Type	☐ Urban ☑ Rural ☐ Metropolitan
4. ☐ Right of Way and Utility Scope	☐ Only R/W acquisition ☐ Only Utility adjustment ☑ Both R/W acquisition and Utility adjustment
5. ☐ Status of Schematic design	☑ Completed ☐ In-progress ☐ Not Started
6. ☐ Status of Boundary Surveying	☑ Completed ☐ In-progress ☐ Not Started

1

7. ☐ Status of Environmental Clearances	☑ Completed ☐ In-progress ☐ Not Started
8. ☐ Status of Right of Way Map	☑ Completed ☐ In-progress ☐ Not Started
9. ☐ Internal R/W Staff Size of a District	☑ Less than 9 FTEs ☐ 9 or more than 9 FTEs
10. ☐ District R/W Annual Budget	☑ Less than $6million ☐ More than $6million
11. ☐ Dedication of Funds to the Project (R/W and Construction)	☑ Yes ☐ No ☐ Unknown
12. ☐ LPA Funded or Non-LPA Funded	☑ LPA funded ☐ Non-LPA funded
13. ☐ Federally Funded or Non-Federally Funded	☑ Federally funded ☐ Non-Federally funded
14. ☐ Funding Limitations for the Project	☐ LPA or Utility Company needing an SIB loan ☐ Partial payments from funding participants ☐ Time required to fund the project ☐ Other ____________ ☑ None
15. ☐ Level of Acceptance of the Project by the Public	☑ Extensive supportive ☐ Not supportive ☐ Mixed
16. ☐ Level of Political Pressure	☐ Extensive ☑ Moderate ☐ Minimal
17. ☐ Common Concerns of Property Owners	☑ Access ☐ Safety ☐ Project duration ☐ Compensation ☐ Other ____________
18. ☐ Current Status of the R/W Project	☐ Request R/W CSJ ☐ Request R/W full release ☐ Assigned R/W CSJ ☑ R/W full release ☐ Pending release

2

Right of Way Acquisition			
Driver	**Value**		
19. ☐ Number of Parcels for Acquisition	☐ Less than 10	☐ 10 to 30	☑ More than 30
20. ☐ Different Types of Parcel Usages	☐ Vacant ☐ Agricultural ☐ Other ______________	☑ Residential ☐ Religious facility	☑ Commercial ☐ Parking lot
21. ☐ Frequency of Eminent Domain Acquisition	☑ Several ☐ Unknown	☐ Some	☐ None
22. ☐ Source of Personnel to be used for R/W Acquisition	☐ Outsourced	☑ District staff	☐ Unknown
23. ☐ Availability of District R/W Appraisers (District Staff and Outsourced)	☐ Adequate	☑ Marginally adequate	☐ Inadequate
24. ☐ Is Funding Available for Outsourcing Staff Assistance?	☑ Yes	☐ No	☐ Unknown
25. ☐ Type of Property Owners	☐ All in-state	☑ Some out-of-state	☐ Unknown
26. ☐ Level of Familiarity with Key Landowners	☑ High	☐ Low	☐ Unknown
27. ☐ Are There Any Property Tenants to Consider?	☐ Yes	☑ No	☐ Unknown
28. ☐ Need for Residential Relocation	☑ Substantial	☐ Some	☐ None
29. ☐ Level of Local Availability of Replacement Housing Facilities	☐ High ☐ Unknown	☐ Medium	☑ Low
30. ☐ Need for Business Relocation	☑ Substantial	☐ Some	☐ None

31. ☐ Level of Local Availability of Replacement Business Facilities	☐ High ☐ Medium ☑ Low ☐ Unknown
32. ☐ Likelihood of Title Curative Actions	☑ High ☐ Medium ☐ Low ☐ Unknown
33. ☐ Responsiveness of Local Title Companies to TxDOT	☑ High ☐ Medium ☐ Low ☐ Unknown
Utility Adjustment	
Driver	**Value**
34. ☐ Have SUE Investigations Been Performed?	☐ Yes ☑ No ☐ Unknown
35. ☐ Will SUE Investigations Be Performed? (If no or unknown in the driver # 34)	☑ Yes ☐ No ☐ Unknown
36. ☐ Utility Type	☐ Overhead power ☐ Buried power ☐ Waste water ☑ Water ☑ Underground communication ☑ Overhead communication ☑ Gas ☑ Other: Electric pipes
37. ☐ Number of Utilities Located in Public R/W	☐ Less than 4 ☑ 4 to 7 ☐ More than 7 ☐ Unknown
38. ☐ Number of Utilities Located in Private Easement	☐ Less than 4 ☑ 4 to 7 ☐ More than 7 ☐ Unknown
39. ☐ Number of Utilities for Adjustments or Relocations	☐ Less than 4 ☐ 4 to 7 ☑ More than 7 ☐ Unknown
40. ☐ Is There Any Utility Adjustment to be Included in the Highway Construction Contract?	☐ Yes ☑ No ☐ Unknown

41. ☐ Responsiveness of Utility Companies to TxDOT Needs	☑ High ☐ Medium ☐ Low ☐ Unknown
42. ☐ Adjustment is Reimbursable Utility or Non-Reimbursable Utility	☑ Reimbursable ☑ Non-reimbursable ☐ Unknown

C.3: MODEL PROJECT (C) DESCRIPTION FORM

MODEL PROJECT (C) DESCRIPTION FORM

Project Basic Facts	
Driver	**Value**
1. ☐ TxDOT Project Type	☐ RER (Rehabilitation of Existing Road) ☑ UGN (Upgrade to Standards Non-Freeway) ☐ NNF (New Location Non-Freeway) ☐ INC (Interchange - New or Reconstructed) ☐ WF (Widen Freeway) ☐ WNF (Widen Non-Freeway) ☐ BR (Bridge Replacement) ☐ CNF (Convert Non-Freeway to Freeway) ☐ HES (Hazard Elimination/Safety) ☐ MSC (Miscellaneous) ☐ NLF (New Location Freeway) ☐ OV (Overlay) ☐ UPG (Upgrade to Standards ☐ BWR (Bridge Widening/Repair)
2. ☐ TxDOT Highway Type	☐ IH (Interstate) ☐ SH (State Highway) ☐ FM (Farm to Market road) ☐ CS (City Street) ☑ US (US highway) ☐ RM (Ranch to Market road)
3. ☐ Project Location Type	☐ Urban ☑ Rural ☐ Metropolitan
4. ☐ Right of Way and Utility Scope	☐ Only R/W acquisition ☐ Only Utility adjustment ☑ Both R/W acquisition and Utility adjustment
5. ☐ Status of Schematic design	☐ Completed ☐ In-progress ☑ Not Started
6. ☐ Status of Boundary Surveying	☐ Completed ☐ In-progress ☑ Not Started

1

7. ☐ Status of Environmental Clearances	☐ Completed ☐ In-progress ☑ Not Started
8. ☐ Status of Right of Way Map	☐ Completed ☐ In-progress ☑ Not Started
9. ☐ Internal R/W Staff Size of a District	☑ Less than 9 FTEs ☐ 9 or more than 9 FTEs
10. ☐ District R/W Annual Budget	☑ Less than $6million ☐ More than $6million
11. ☐ Dedication of Funds to the Project (R/W and Construction)	☑ Yes ☐ No ☐ Unknown
12. ☐ LPA Funded or Non-LPA Funded	☑ LPA funded ☐ Non-LPA funded
13. ☐ Federally Funded or Non-Federally Funded	☑ Federally funded ☐ Non-Federally funded
14. ☐ Funding Limitations for the Project	☐ LPA or Utility Company needing an SIB loan ☐ Partial payments from funding participants ☐ Time required to fund the project ☐ Other ____________ ☑ None
15. ☐ Level of Acceptance of the Project by the Public	☐ Extensive supportive ☐ Not supportive ☑ Mixed
16. ☐ Level of Political Pressure	☐ Extensive ☑ Moderate ☐ Minimal
17. ☐ Common Concerns of Property Owners	☐ Access ☐ Safety ☑ Project duration ☐ Compensation ☐ Other ____________
18. ☐ Current Status of the R/W Project	☐ Request R/W CSJ ☐ Request R/W full release ☐ Assigned R/W CSJ ☑ R/W full release ☑ Pending release

Right of Way Acquisition			
Driver	**Value**		
19. ☐ Number of Parcels for Acquisition	☐ Less than 10	☐ 10 to 30	☑ More than 30
20. ☐ Different Types of Parcel Usages	☐ Vacant ☑ Agricultural ☐ Other ______________	☐ Residential ☐ Religious facility	☐ Commercial ☐ Parking lot
21. ☐ Frequency of Eminent Domain Acquisition	☐ Several ☐ Unknown	☑ Some	☐ None
22. ☐ Source of Personnel to be used for R/W Acquisition	☑ Outsourced	☐ District staff	☐ Unknown
23. ☐ Availability of District R/W Appraisers (District Staff and Outsourced)	☑ Adequate	☐ Marginally adequate	☐ Inadequate
24. ☐ Is Funding Available for Outsourcing Staff Assistance?	☑ Yes	☐ No	☐ Unknown
25. ☐ Type of Property Owners	☐ All in-state	☐ Some out-of-state	☑ Unknown
26. ☐ Level of Familiarity with Key Landowners	☐ High	☑ Low	☐ Unknown
27. ☐ Are There Any Property Tenants to Consider?	☐ Yes	☑ No	☐ Unknown
28. ☐ Need for Residential Relocation	☑ Substantial	☐ Some	☐ None
29. ☐ Level of Local Availability of Replacement Housing Facilities	☐ High ☐ Unknown	☐ Medium	☑ Low
30. ☐ Need for Business Relocation	☐ Substantial	☐ Some	☑ None

Driver	Value
31. ☐ Level of Local Availability of Replacement Business Facilities	☐ High ☐ Medium ☐ Low ☑ Unknown
32. ☐ Likelihood of Title Curative Actions	☐ High ☐ Medium ☐ Low ☑ Unknown
33. ☐ Responsiveness of Local Title Companies to TxDOT	☐ High ☐ Medium ☐ Low ☑ Unknown
Utility Adjustment	
Driver	**Value**
34. ☐ Have SUE Investigations Been Performed?	☑ Yes ☐ No ☐ Unknown
35. ☐ Will SUE Investigations Be Performed? (If no or unknown in the driver # 34)	☐ Yes ☑ No ☐ Unknown
36. ☐ Utility Type	☑ Overhead power ☑ Buried power ☐ Waste water ☑ Water ☑ Underground communication ☑ Overhead communication ☑ Gas
37. ☐ Number of Utilities Located in Public R/W	☐ Less than 4 ☑ 4 to 7 ☐ More than 7 ☐ Unknown
38. ☐ Number of Utilities Located in Private Easement	☐ Less than 4 ☑ 4 to 7 ☐ More than 7 ☐ Unknown
39. ☐ Number of Utilities for Adjustments or Relocations	☐ Less than 4 ☐ 4 to 7 ☑ More than 7 ☐ Unknown
40. ☐ Is There Any Utility Adjustment to be Included in the Highway Construction Contract?	☐ Yes ☑ No ☐ Unknown
41. ☐ Responsiveness of Utility Companies to TxDOT Needs	☑ High ☐ Medium ☐ Low

	☐ Unknown
42. ☐ Adjustment is Reimbursable Utility or Non-Reimbursable Utility	☑ Reimbursable ☑ Non-reimbursable ☐ Unknown

Appendix D: Questionnaire for Data Collection

No: **Date:** _______________

This questionnaire is designed to collect data for the research being conducted by Texas Department of Transportation and The University of Texas at Austin. Your responses are extremely important to conduct subsequent research steps and for the success of this project. Your responses will be treated with ***CONFIDENTIAL*** and data will be presented in such a way that your identity cannot be connected with specific published data. Thus, we encourage you to read through *ALL* of the questions and answer them beforehand as much as possible. Please fill out the personal information as well. Thank you in advance for your participation.

---

1. General Information

Please answer the following questions so that we can get a better understanding of your professional background.

A. Personal information

Name:______________________________

Email address:________________________ Phone number:________________________

B. Current district

☐Abilene	☐Amarillo	☐Austin	☐Beaumont
☐Childress	☐San Angelo	☐Lufkin	☐El Paso
☐Laredo	☐Odessa	☐Bryan	☐Wichita Falls
☐Other ________________			

C. Current position title

☐R/W administrator	☐R/W appraiser	☐R/W agent
☐Utility agent	☐Other ________________	

D. Number of years of industry experience in R/W or (and) Utility adjustment work

____

E. Briefly describe the main duties of your current position over the past three years

____

____

____

____

____

1

2. Pre-Application Importance of the Key Drivers in the R/W Acquisition and Utility Adjustment Processes

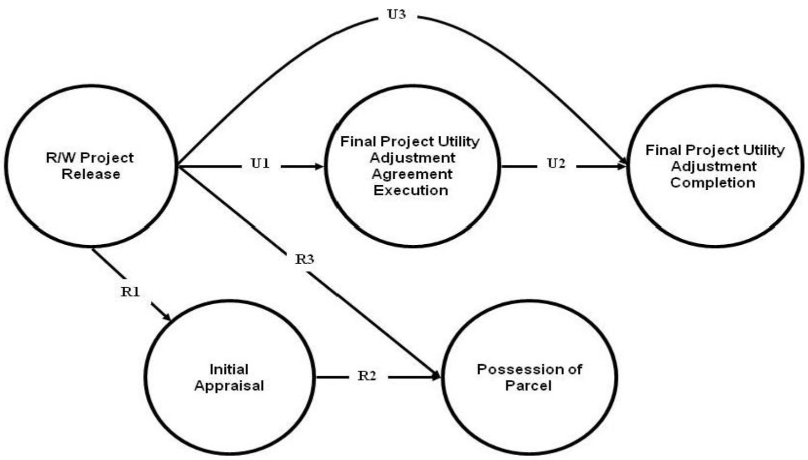
The following matrix is intended to evaluate the level of importance of the drivers used in predicting durations for acquiring right of way and adjusting utilities. Choose a value that best describes the level of importance of the driver.

Driver	Level of Importance in Determining Durations			
Project Basic Facts	**Not Important**	**Low**	**Moderate**	**High**
1. TxDOT Project Type	☐	☐	☐	☐
2. TxDOT Highway Type	☐	☐	☐	☐
3. Project Location Type	☐	☐	☐	☐
4. Right-of-Way and Utility Scope	☐	☐	☐	☐
5. Status of Schematic Design	☐	☐	☐	☐
6. Status of Boundary Surveying	☐	☐	☐	☐
7. Status of Environmental Clearance	☐	☐	☐	☐
8. Status of Right-of-Way Map	☐	☐	☐	☐
9. Internal R/W Staff Size of a District	☐	☐	☐	☐
10. District R/W Annual Budget	☐	☐	☐	☐
11. Dedication of Funds to the Project (R/W and Construction)	☐	☐	☐	☐
12. LPA Funded or Non-LPA Funded	☐	☐	☐	☐
13. Federally Funded or Non-Federally Funded	☐	☐	☐	☐
14. Funding Limitations for the Project	☐	☐	☐	☐
15. Level of Acceptance of the Project by the Public	☐	☐	☐	☐
16. Level of Political Pressure	☐	☐	☐	☐
17. Common Concerns of Property Owners	☐	☐	☐	☐
18. Current Status of the R/W Project	☐	☐	☐	☐
Right of Way Acquisition	**Not Important**	**Low**	**Moderate**	**High**
19. Number of Parcels for Acquisition	☐	☐	☐	☐

20. Different Types of Parcel Usages	☐	☐	☐	☐
21. Frequency of Eminent Domain	☐	☐	☐	☐
22. Source of Personnel to be used for R/W Acquisition	☐	☐	☐	☐
23. Availability of District R/W Appraisers (District Staff and Outsourced)	☐	☐	☐	☐
24. Is Funding Available for Outsourcing Staff Assistance?	☐	☐	☐	☐
25. Type of Property Owners	☐	☐	☐	☐
26. Level of Familiarity with Key Landowners	☐	☐	☐	☐
27. Are There Any Property Tenants to Consider?	☐	☐	☐	☐
28. Need for Residential Relocation	☐	☐	☐	☐
29. Level of Local Availability of Replacement Housing Facilities	☐	☐	☐	☐
30. Need for Business Relocation	☐	☐	☐	☐
31. Level of Local Availability of Replacement Business Facilities	☐	☐	☐	☐
32. Likelihood of Title Curative Actions	☐	☐	☐	☐
33. Responsiveness of Local Title Companies to TxDOT	☐	☐	☐	☐
Utility Adjustment	**Not Important**	**Low**	**Moderate**	**High**
34. Have SUE Investigations Been Performed?	☐	☐	☐	☐
35. Will SUE Investigations Be Performed? (If no or unknown in the driver # 34)	☐	☐	☐	☐
36. Utility Type	☐	☐	☐	☐
37. Number of Utilities Located in Public R/W	☐	☐	☐	☐
38. Number of Utilities Located in Private Easement	☐	☐	☐	☐
39. Number of Utilities for Adjustments or Relocations	☐	☐	☐	☐
40. Is there any Utility Adjustment to be Included in the Highway Construction Contract?	☐	☐	☐	☐
41. Responsiveness of Utility Companies to TxDOT Needs	☐	☐	☐	☐
42. Adjustment is Reimbursable Utility or Non-Reimbursable Utility	☐	☐	☐	☐

No: Name: ________________

Non-RUDI Based Duration Estimate



Project ID	Non-RUDI Based Duration Estimate		
	R1	R2	R3
	U1	U2	U3

Please provide additional information used in your non-RUDI based estimates.

1) ______________________________

2) ______________________________

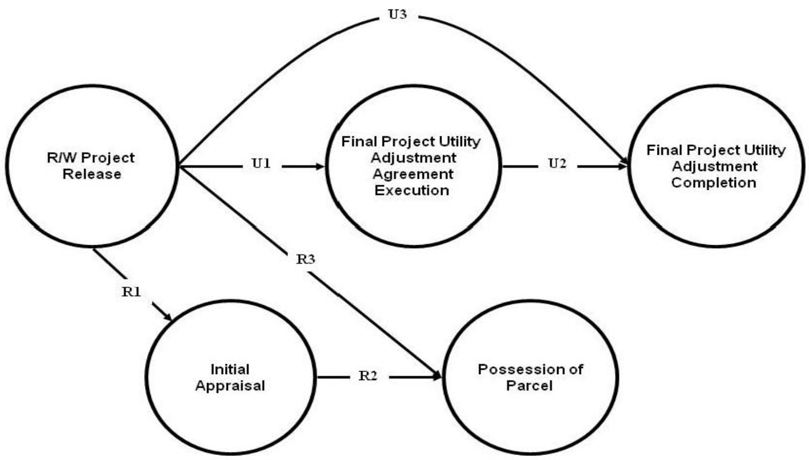
3) ______________________________

4) ______________________________

5) ______________________________

No: **Name:** ________________

RUDI Based Duration Estimate



Project ID	RUDI Based Duration Estimate		
	R1	R2	R3
	U1	U2	U3

Please provide additional information used in your RUDI based estimates.

1) ____________________
2) ____________________
3) ____________________
4) ____________________
5) ____________________
6) ____________________

5

Comparison of Non-RUDI Based and RUDI Based Estimates

Project ID	Non-RUDI Duration Estimate		RUDI-Based Duration Estimate		Difference	
					Days	%
	R1			**R1**		
	R2			**R2**		
	R3			**R3**		
	U1			**U1**		
	U2			**U2**		
	U3			**U3**		

If there is difference between Non-RUDI based estimate and RUDI based estimate, please provide your reasons for the differences.

1) ______________________________

2) ______________________________

3) ______________________________

4) ______________________________

5) ______________________________

6) ______________________________

No: **Name:** ______________________

3. Post-Application Importance of the Key Drivers in the R/W Acquisition and Utility Adjustment Processes
The following form is intended to assess the importance of the drivers used in determining durations of the R/W acquisition and Utility adjustment processes of Model project B. The common question for the drivers is '**Is this driver significant in determining your durations**?' If critical, check the "Yes" box. If not critical, check the "No" box.

Project Basic Facts		Significant Duration Driver?	
Driver	**Value**	**Yes**	**No**
1. TxDOT Project Type	☑ RER (Rehabilitation of Existing Road) ☐ UGN (Upgrade to Standards Non-Freeway) ☐ NNF (New Location Non-Freeway) ☐ INC (Interchange - New or Reconstructed) ☐ WF (Widen Freeway) ☐ WNF (Widen Non-Freeway) ☐ BR (Bridge Replacement) ☐ CNF (Convert Non-Freeway to Freeway) ☐ HES (Hazard Elimination/Safety) ☐ MSC (Miscellaneous) ☐ NLF (New Location Freeway) ☐ OV (Overlay) ☐ UPG (Upgrade to Standards ☐ BWR (Bridge Widening/Repair)	☐	☐
2. TxDOT Highway Type	☐ IH (Interstate) ☐ SH (State Highway) ☑ FM (Farm to Market road) ☐ CS (City Street) ☐ US (US highway) ☐ RM (Ranch to Market road)	☐	☐
3. Project Location Type	☐ Urban ☑ Rural ☐ Metropolitan	☐	☐

4. Right-of-Way and Utility Scope	☐ Only R/W acquisition ☐ Only Utility adjustment ☑ Both R/W acquisition and Utility adjustment	☐	☐
5. Status of Schematic Design	☑ Completed ☐ In-progress ☐ Not Started	☐	☐
6. Status of Boundary Surveying	☑ Completed ☐ In-progress ☐ Not Started	☐	☐
7. Status of Environmental Clearance	☑ Completed ☐ In-progress ☐ Not Started	☐	☐
8. Status of Right-of-Way Map	☑ Completed ☐ In-progress ☐ Not Started	☐	☐
9. Internal R/W Staff Size of a District	☑ Less than 9 FTEs ☐ 9 or more than 9 FTEs	☐	☐
10. District R/W Annual Budget	☑ Less than $6million ☐ More than $6million	☐	☐
11. Dedication of Funds to the Project (R/W and Construction)	☑ Yes ☐ No ☐ Unknown	☐	☐
12. LPA Funded or Non-LPA Funded	☑ LPA funded ☐ Non-LPA funded	☐	☐
13. Federally Funded or Non-Federally Funded	☑ Federally funded ☐ Non-Federally funded	☐	☐
14. Funding Limitations for the Project	☐ LPA or Utility Company needing an SIB loan ☐ Partial payments from funding participants ☐ Time required to fund the project ☐ Other ________________ ☑ None	☐	☐
15. Level of Acceptance of the Project by the Public	☑ Extensive supportive ☐ Not supportive ☐ Mixed	☐	☐
16. Level of Political Pressure	☐ Extensive ☑ Moderate ☐ Minimal	☐	☐

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17. Common Concerns of Property Owners	☑ Access ☐ Safety ☐ Project duration ☐ Compensation ☐ Other ________	☐	☐
18. Current Status of the R/W Project	☐ Request R/W CSJ ☐ Request R/W full release ☐ Assigned R/W CSJ ☑ R/W full release ☐ Pending release	☐	☐
Right of Way Acquisition		**Significant Duration Driver?**	
Driver	**Value**	**Yes**	**No**
19. Number of Parcels for Acquisition	☐ Less than 10 ☐ 10 to 30 ☑ More than 30	☐	☐
20. Different Types of Parcel Usages	☐ Vacant ☑ Residential ☑ Commercial ☐ Agricultural ☐ Religious facility ☐ Parking lot ☐ Other ________	☐	☐
21. Frequency of Eminent Domain	☑ Several ☐ Some ☐ None ☐ Unknown	☐	☐
22. Source of Personnel to be used for R/W Acquisition	☐ Outsourced ☑ District staff ☐ Unknown	☐	☐
23. Availability of District R/W Appraisers (District Staff and Outsourced)	☐ Adequate ☑ Marginally adequate ☐ Inadequate	☐	☐
24. Is Funding Available for Outsourcing Staff Assistance?	☑ Yes ☐ No ☐ Unknown	☐	☐
25. Type of Property Owners	☐ All in-state ☑ Some out-of-state ☐ Unknown	☐	☐
26. Level of Familiarity with Key Landowners	☑ High ☐ Low ☐ Unknown	☐	☐
27. Are There Any Property Tenants to Consider?	☐ Yes ☑ No ☐ Unknown	☐	☐

28. Need for Residential Relocation	☑ Substantial ☐ Some ☐ None	☐	☐
29. Level of Local Availability of Replacement Housing Facilities	☐ High ☐ Medium ☑ Low ☐ Unknown	☐	☐
30. Need for Business Relocation	☑ Substantial ☐ Some ☐ None	☐	☐
31. Level of Local Availability of Replacement Business Facilities	☐ High ☐ Medium ☑ Low ☐ Unknown	☐	☐
32. Likelihood of Title Curative Actions	☑ High ☐ Medium ☐ Low ☐ Unknown	☐	☐
33. Responsiveness of Local Title Companies to TxDOT	☑ High ☐ Medium ☐ Low ☐ Unknown	☐	☐
Utility Adjustment		**Significant Duration Driver?**	
Driver	**Value**	**Yes**	**No**
34. Have SUE Investigations Been Performed?	☐ Yes ☑ No ☐ Unknown	☐	☐
35. Will SUE Investigations Be Performed? (If no or unknown in the driver #34)	☑ Yes ☐ No ☐ Unknown	☐	☐
36. Utility Type	☐ Overhead power ☐ Buried power ☐ Waste water ☑ Water ☑ Underground communication ☑ Overhead communication ☐ Gas ☑ Other: Electric pipes	☐	☐
37. Number of Utilities Located in Public R/W	☐ Less than 4 ☑ 4 to 7 ☐ More than 7 ☐ Unknown	☐	☐

Appendix E: Project Duration Record Form in RUDI

R/W ACQUISITION AND UTILITY ADJUSTMENT PROCESS DURATION RECORD FORM

Project CSJ	
Project Title	
Date of Analysis	
Name of Analyst	
Project Description	
Unusual Circumstances (I,e. congested corridor, wetlands, lawyer activity, etc., if known)	
Project Current Status	

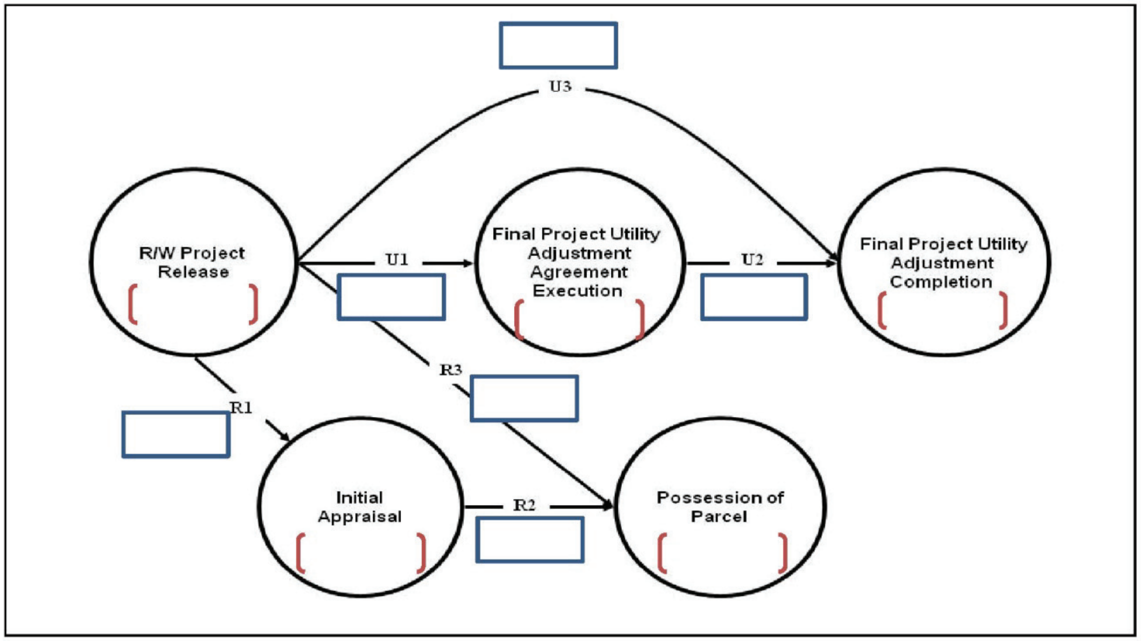
RIGHT OF WAY ACQUISITION PROCESS DURATIONS

Choices			R1				R2				R3			
			From R/W Project Release To Initial Appraisal				From Initial Appraisal To Possession of Parcel				From R/W Project Release To Possession of Parcel			
			Degree of Schedule Urgency L ☐ M ☐ H ☐				Degree of Schedule Urgency L ☐ M ☐ H ☐				Degree of Schedule Urgency L ☐ M ☐ H ☐			
			Degree of Uncertainty L ☐ M ☐ H ☐				Degree of Uncertainty L ☐ M ☐ H ☐				Degree of Uncertainty L ☐ M ☐ H ☐			
			Percentiles		Duration		Percentiles		Duration		Percentiles		Duration	
			Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher
Number of Parcels	Less than 10	☐												
	10 or greater	☐												
	30 or less	☐												
	More than 30	☐												
Location Type	Urban	☐												
	Rural	☐												
District ROW Staff Size	Less than 9 FTEs	☐												
	9 or more FTEs	☐												
District Annual ROW Budget	Less than $6 million	☐												
	More than $6 million	☐												
Average														
Range														
Recommended duration														

UTILITY ADJUSTMENT PROCESS DURATIONS

Choices			U1				U2				U3			
			From R/W Project Release To Final Project Utility Adjustment Agreement Execution				From Final Project Utility Adjustment Agreement Execution To Final Project Utility Adjustment Completion				From R/W Project Release To Final Project Utility Adjustment Completion			
			Degree of Schedule Urgency L ☐ M ☐ H ☐				Degree of Schedule Urgency L ☐ M ☐ H ☐				Degree of Schedule Urgency L ☐ M ☐ H ☐			
			Degree of Uncertainty L ☐ M ☐ H ☐				Degree of Uncertainty L ☐ M ☐ H ☐				Degree of Uncertainty L ☐ M ☐ H ☐			
			Percentiles		Duration		Percentiles		Duration		Percentiles		Duration	
			Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher
TxDOT Highway Type														
TxDOT Project Type														
Utility Type														
Reimbursable	Reimbursable	☐												
	Non-Reimbursable	☐												
LPA Funding	LPA Funded	☐												
	Non-Funded	☐												
Federal Funding	Federally Funded	☐												
	Non-Federally Funded	☐												
Location Category	Urban	☐												
	Rural	☐												
	Metropolitan	☐												
Utility Adjustment Speed	Quick	☐												
	Slow	☐												
Average														
Range														
Recommended duration														

KEY PROCESS MILESTONES



RECOMMENDED DURATIONS AND MILESTONE DATES

Right Of Way Acquisition	Utility Adjustment
Justifications	

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Vita

Taehong Sohn was born in Busan, Korea on July 21, 1972. He is a son of Youngsang Sohn and Soojeong Lee and has an older sister, Aekyoung Sohn. In 2003, he married his wife, Seunghee Choi, and has a daughter, Eubin Sohn. He entered Kangnam University in March 1997 after graduating from Induk Institute of Technology in February 1997 and completing his military service in the Korean army. He received the degree of Bachelor of Engineering in Architectural Engineering in February 1999. After completing the undergraduate, he worked for Hanshin Construction Corporation from 2000 to 2001 as a project engineer and safety manager responsible for managing construction tasks and crews as well as conducting safety plans and programs to secure the site conditions for crews and staff.

Then, in order to pursue his Master's degree, he entered the Construction Management programs of the School of Building Construction at Virginia Tech (Virginia Polytechnic Institute and State University) at Blacksburg in the United States in August 2003. After his Master's degree at Virginia Tech in May 2005, he enrolled at the University of Texas at Austin to pursue his Ph.D. degree in the Construction Engineering and Project Management programs under the Department of Civil, Architectural, and Environmental Engineering, in August 2005.

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